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PERMANENT FILE

LITERATURE

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X-1850 2M 10-54

TESTING ROOF BOLT IN MINE

Hydraulic cylinders pull on tie to overhead rock to find gripping strength

(SEE INDEX PAGE AND PAGE 119)

VOLUME 56 • NUMBER 5 3/p of 48 in April. NEW YORK • LONDON

NEW GRINDER SAFETY with GREATER POWER

INGERSOLL-RAND *introduces* ANOTHER BIG FIRST... *the* NEW OVERSPEED SAFETY COUPLING....

GRINDER OPERATORS *Also Asked for* THESE *Extra* FEATURES

LONG LIFE ARBOR CONSTRUCTION—Widely spaced, permanently lubricated, precision ball bearings are located at each end of the arbor in a one-piece housing to provide new rigidity and longer Grinder life.

20% MORE POWER—A new, larger, four-vane, swastika-type motor gives 20% more power. Extensive use of light weight alloy castings results in more horsepower per pound. Grinding efficiency goes up and grinding costs come down.

QUIETER EXHAUST—It takes 10 of these new Grinders to produce exhaust noise equal to 1 of the previous machines. The low exhaust noise which is present, is pitched so as not to be irritating.

EXTRA EXHAUST POSITIONS—The operator can choose any one of four exhaust positions, spaced 90 degrees apart.

RUBBER-FACED VALVE—The new composition rubber-faced throttle valve closes properly even if small particles of foreign matter adhere to the valve seat. Replacement is inexpensive, and no lapping is necessary.

OPTIONAL HANDLE—In addition to the popular grip handle, a straight handle with a new safety-throttle lock is available.

Call us today and arrange for a demonstration of this powerful new Series 4 Air Grinder.

The Overspeed Safety Coupling supplements, and is completely independent of, the regular factory-set weight type governor used in Ingersoll-Rand Air Tools.

This built-in unit, which operates in case of failure of the regular governor, eliminates the possibility of dangerous overspeed operation. If, for any reason, the motor speed exceeds the safe wheel speed, the NEW Overspeed Safety Coupling automatically uncouples the arbor and the wheel from the motor, making it impossible to operate the Grinder until the cause of overspeeding has been corrected.

Ingersoll-Rand

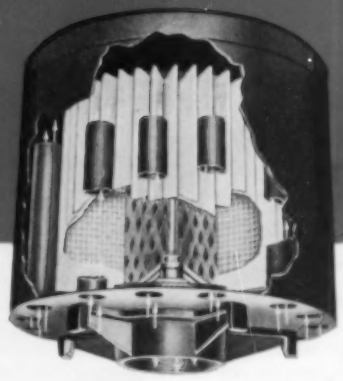
630-B

11 BROADWAY, NEW YORK 4, N. Y.

IT FILTERS!

IT SILENCES!

CUTAWAY VIEW



STAYNEW MODEL DS INTAKE FILTER

Both silencing and filtering in a single compact unit! All the outstanding advantages of the original Staynew Dry-Type Radial Fin Construction: low resistance to air flow; increased efficiency with use; suitability for use on carbon ring compressors; no oil, viscous coating or charging tanks; no moving parts; inserts easily and inexpensively cleaned or replaced.

Silencing is efficiently handled without excess back pressure thru a series of cylindrical rectifying chambers of scientific diameter to length ratio.

Thousands of these well-designed, well-built Staynew Filters are already in use, saving wear on compressor and internal combustion engines, reducing intake clamor.

FOR COMPLETE DETAILS WRITE:

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

7 CENTRE PK., ROCHESTER 3, N. Y.

IN CANADA: Toronto - McCarthy and Robinson Montreal - Engineering Equipment Co. IN FRANCE: Paris - Société Tecalemit

NEW

SERIES 12100*

FORGED STEEL

DROP

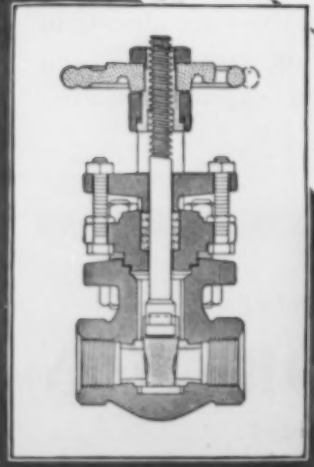
Vogt

BOLTED BONNET
BOLTED GLAND

150-800 POUND

GATE VALVES

SIZES 1/4" to 2"



***Series 12100**

CARBON STEEL { 800 Pounds @ 750° F. / 1500 Pounds Cold Non-Shock

For 150-800 pounds service • Round Bolted Bonnet • Bolted Gland • Gasket or Ground Joint • Outside Screw and Yoke • Renewable Seat Rings • Solid Wedge — Slotted Type • Rising Stem 11½-13% Chrome Stainless Steel Trimmings • Sizes 1/4" to 2" inclusive.

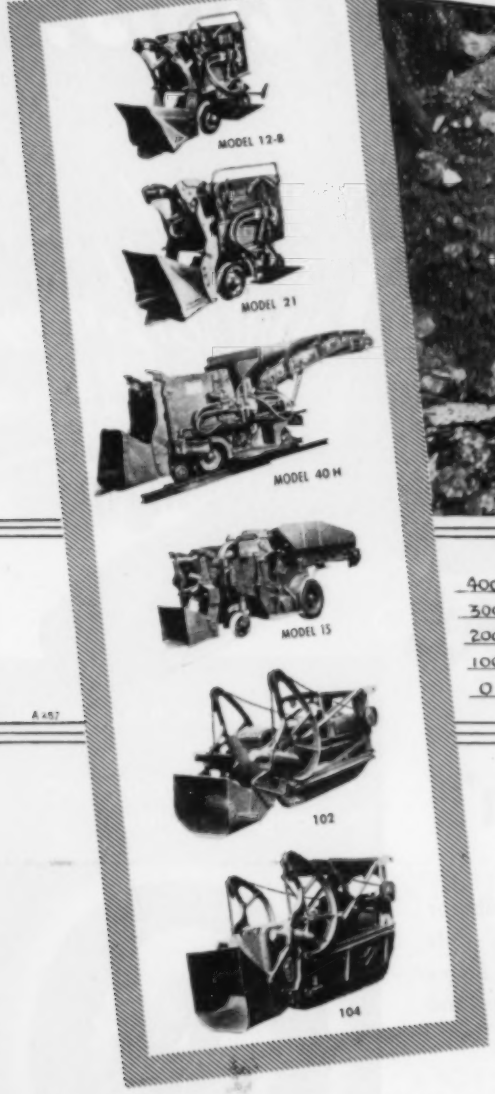
HENRY VOGT MACHINE CO. *Louisville 10, Ky.*

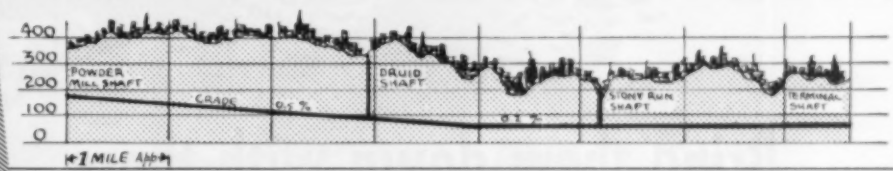
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • DALLAS

CASE HISTORY OF A SUCCESSFUL TUNNEL JOB

FROM THE EIMCO FILE T190

BALTIMORE TUNNEL





A-457

SPECIFICATIONS

Length of this section of tunnel—7 miles.

Size heading—7′ (3 miles) 10′ (4 miles).

Headings worked—6 — Advance, average 2500′ per month, maximum 5000′ per month. 32 hole 9′ round drilled. 150 to 225 pounds of 40 or 60% powder (depending on rock) per round. Average about 7 pounds per cu. yd. of rock broken. Mucking time average 1 hour, 15 minutes. Mucking machines—Model 40 Eimcos.

The contractor responsible for driving high speed rock tunnels is required to be many things—a competent engineer, a geologist, a mechanic, an expert in labor relations and all of the other skills which the inevitible uncertainty of this work presents.

He must, therefore, be exacting and doubly cautious in his selection of machines. There can be no questions, no uncertainties about the machines doing their jobs, no matter how tough the going.

This is the reason you will find Eimco machines on the big majority of tunnel jobs the world over. There are no uncertainties when you have an Eimco loading out the round. It is fast, safe and low in cost regardless of conditions. You can't beat an Eimco for absolute dependability.

You can't beat an Eimco!

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

BRANCH SALES AND SERVICE OFFICES:

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
BIRMINGHAM, ALA., 3140 FAYETTE AVE • DULUTH, MINN., 216 E. SUPERIOR ST.
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIFORNIA, P. O. BOX 240
KELLOGG, IDAHO, 307 DIVISION STREET

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

Bring them down with these DAYTON Cog-Belt*"teeth"

- 40% more h.p. per belt
- fewer belts
- fewer pulley grooves
- longer belt life

Switch to premium Dayton Cog-Belts and watch the cost of power transmission come tumbling down. Original cost is less. 5 Dayton Cog-Belts do the work of 7 ordinary V-Belts.

You save drive space. Cog-Belts let you use up to 25% shorter center-to-center pulley distances.

Cogs are the *only* V-Belts scientifically built to bend, like your finger. They withstand flexing and compression strains better, run cooler, last longer.

To get shut of V-Belt troubles for the duration, to save money and drive space, give your Dayton Distributor the "high-sign" of better V-Belt power transmission: the arched finger that means Dayton Cog-Belts and important savings!

COGS FIX FLATS!

Dayton Cog-Belts converted a compressor drive in a railroad shop, from a flat drive that averaged 6 breakdowns a year, to a trouble-free V-flat drive now going into its tenth year of service. Cogs need no special pulleys, grip so well they convert flat to V-flat with only one pulley change!

DAYTON RUBBER COMPANY • DAYTON 1, OHIO

V-Belts by **Dayton Rubber**

*T.M.

WORLD'S LARGEST MANUFACTURER OF V-BELTS

FOR HALF A CENTURY—

SPECIALISTS IN THE DESIGN,

MANUFACTURE AND APPLI-

CATION OF INDUSTRIAL

ELECTRIC MOTORS

In the March of Electric Motor Progress—we have lead the way in many developments of far-reaching importance to Industry. For half a century, we have created, pioneered, and built specially designed electric motors for the exacting requirements of this country's outstanding machinery manufacturers.

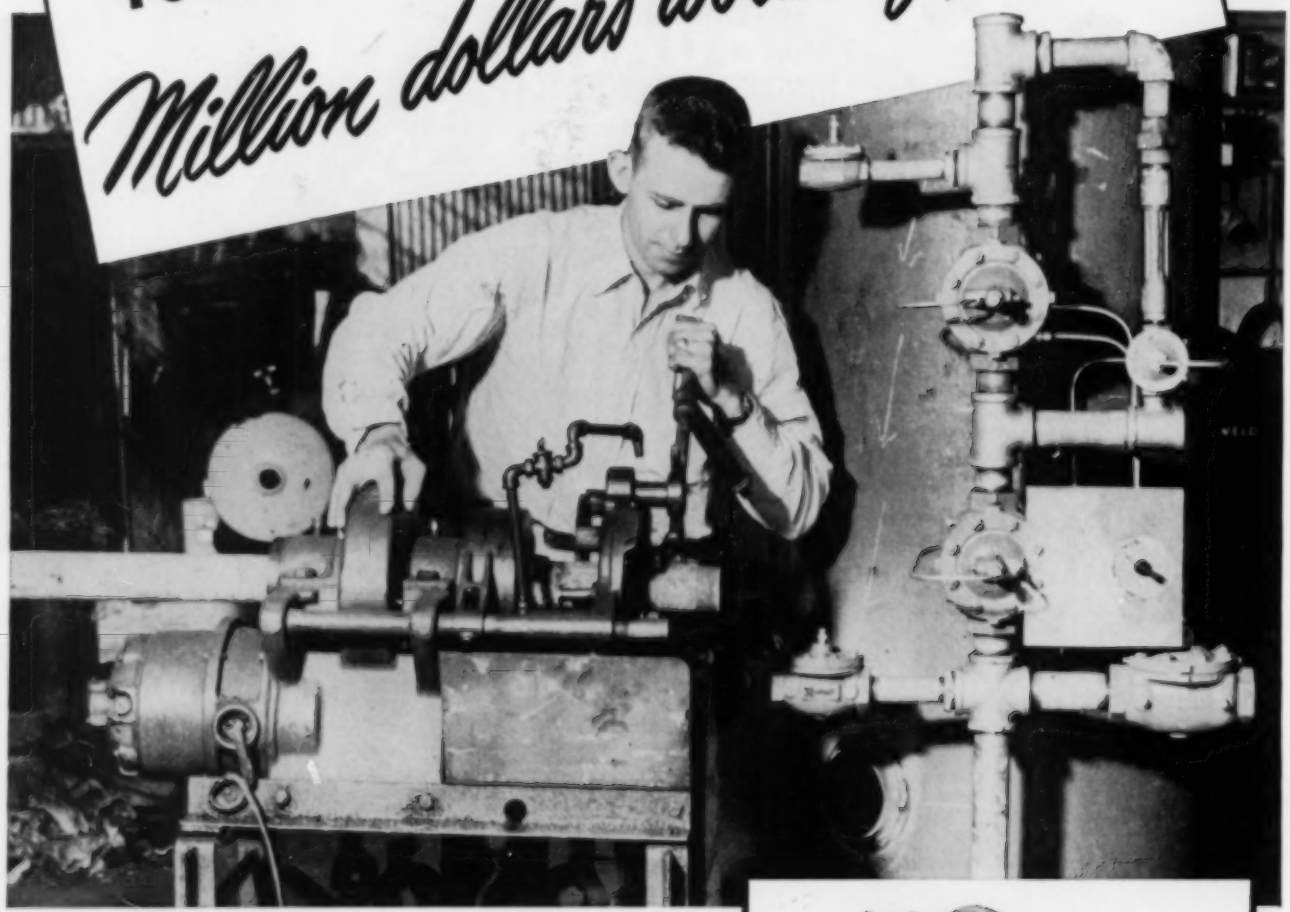
No matter what your motor requirements are—whether special or standard—you can depend upon Louis Allis.

THE LOUIS ALLIS CO.

MILWAUKEE 7 WISCONSIN

50th YEAR 1901-1951

TOLEDO MACHINE THREADS *Million dollars' worth of pipe!*



USED 20 YEARS BY TEXAS PLANT

"We use a Toledo #999 2" Pipe Machine daily in fabrication of our water treating equipment," says E. B. Hudson, Jr., president of Hudson Water Softener Corp., San Antonio, Texas. "It has cut the threads on over a million dollars' worth of pipe since August 1931."

Mr. Hudson declares, "I know of no equipment we own that has given more satisfaction than our Toledo #999 at less operating cost."

This machine makes friends with users everywhere! *Speeds production . . . cuts costs!* Threads 2" pipe in 22 seconds . . . cuts off 2" pipe in 10 seconds. Compact . . . portable . . . efficient . . . use it anywhere in your shop, plant or on the job. Your choice—Wheel or Knife Cut-Off. Toledo-built dependability. Write for catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

Your Choice . . .

Tool up *right* with TOLEDO! Hand tools, all pipe sizes, ¼" to 12" and ¼" to 1" bolts. Power pipe machines, up to 2" and 4" capacity.

RELY ON THE LEADER

TOLEDO

PIPE TOOLS...POWER PIPE MACHINES...POWER DRIVES

Don't Let IRON and STEEL SCRAP Gather Cobwebs!

Somewhere, back in a corner of your plant or shop, there's some scrap iron and steel. Maybe quite a pile, gathering rust. Maybe some obsolete machinery, long unused. Maybe odds and ends that total many tons. You've meant to have it hauled away, but somehow it's still around.

Now's the time to sell it!

Call the nearest scrap dealer; ask him to give you a price. He'll pay good money for it. Prices are high . . . the nation's steel plants need scrap badly. With a stepped-up defense program under way, scrap is more than ever a vital ingredient of steel production. Industry must help take up the slack—*fast*.

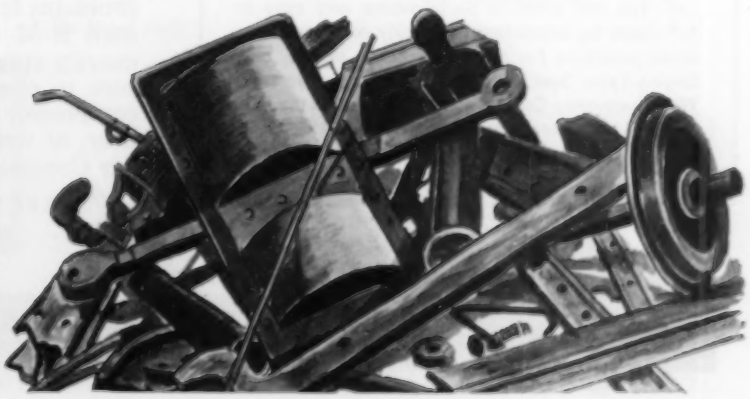
A constant flow of scrap means greater tonnages of iron and steel. It means more finished products made of iron and steel. You can help . . . and help yourself as well. Get that scrap in circulation. Get it on the job!

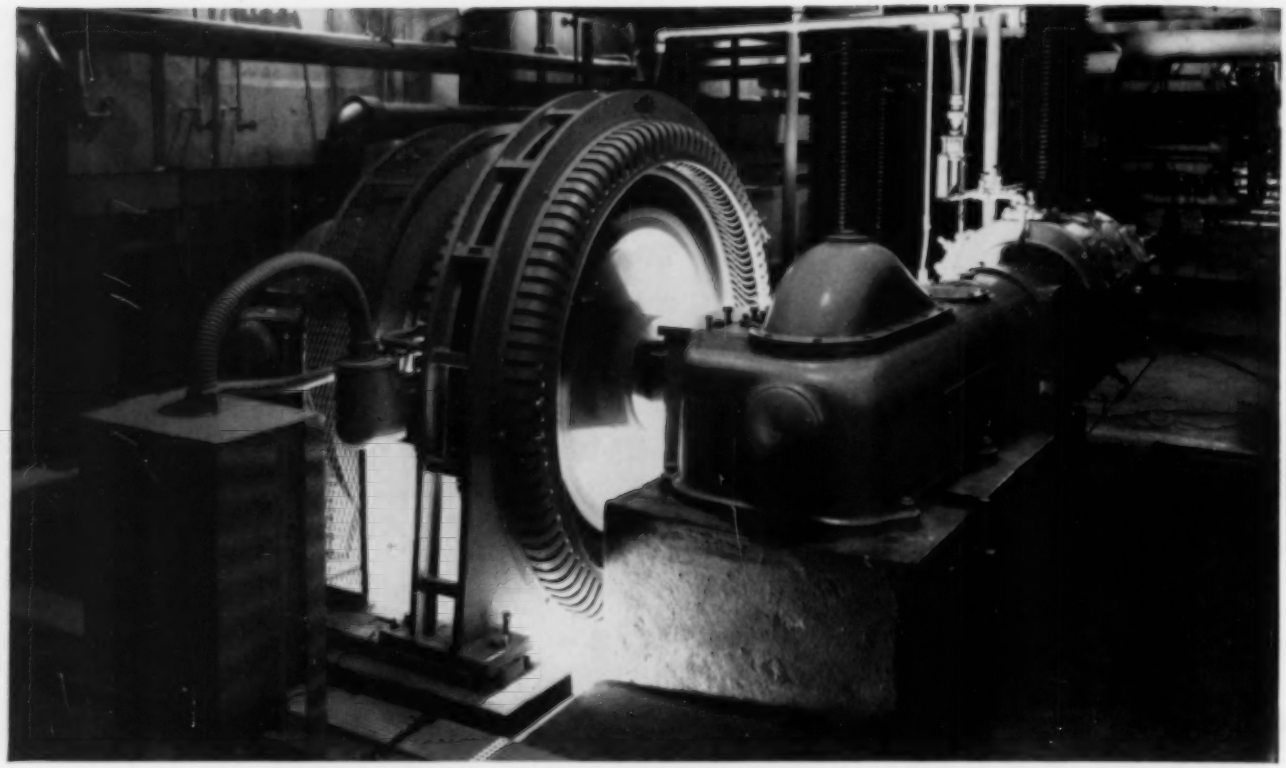
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

BETHLEHEM STEEL

BETHLEHEM STEEL

If you don't know the name of a scrap dealer, look one up in the yellow classified pages of the telephone directory. You'll find a listing there.





Here's the Perfect Partner for your Large Compressor

Advantages for you to remember:

1. You save money with E-M Engine-Type Synchronous Motors. No belts to buy . . . and space-saving direct mounting on the crankshaft puts installation cost at minimum. Full-voltage starting is economical. Soundly engineered, efficient design gives you lowest operating cost.

2. You're assured of long-life, trouble-free service. Frames of E-M Motors are heavy deep-section fabricated steel, reinforced and welded into a single unit. Wide rotor spokes have high torsional strength, and field poles are securely anchored with a liberal safety factor.

3. You can profit in performance and save in costs by contacting E-M early on compressor drive problems. For reliable, efficient service, E-M Engine-Type Synchronous Motors and Polarized Field Frequency Control are recognized as the *best* for any large compressor operation.

E-M Engine-Type Synchronous Motors are made-to-order for compressor drives

● Linked hand in hand for dependable production at Parke, Davis & Company in Detroit (above) are the reciprocating air compressor and its most important working partner . . . an E-M Engine-Type Synchronous Motor.

The advantages you get in economical operation, space-saving installation and low maintenance costs have made E-M Engine-Type Synchronous Motors "perfect partners" for large reciprocating compressors.

This closely matched association of compressor and motor offers you significant benefits. These direct-connected motors, having only a stator and rotor, give you unbeatable simplicity, efficiency and low cost service. The E-M Polarized Field Frequency Control insures perfect synchronizing and complete motor protection.

E-M engineers have met and solved compressor drive problems for nearly 40 years. As a result, they can design each E-M Engine-Type Synchronous Motor to match exactly specific compressor operating characteristics. Be sure to check E-M before you specify your next large compressor installation. Contact your E-M field engineer, or write the factory for E-M's 24-page booklet on Air Compressors . . . ask for Synchronizer No. 32.

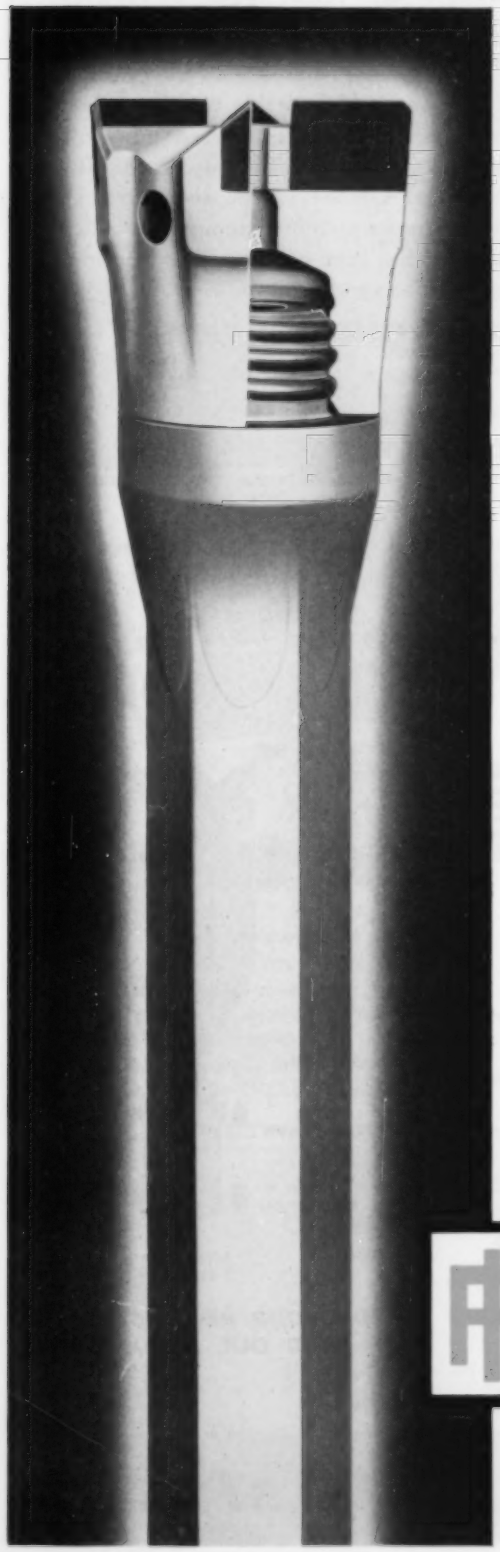
ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1200-TPA-2098

SYNCHRONOUS MOTORS AND CONTROLS FOR LARGE COMPRESSOR DRIVES

Here's why

CARSET JACKBITS



have changed the entire concept of today's rock drilling costs

Since the advent of the Carset Jackbit, drilling costs can no longer be reckoned *only* in terms of bit cost per foot of hole. For this is only *one of many* items where Carset Jackbits have made possible tremendous over-all savings.

Check the fourteen economies listed below. Note how any one of them by itself makes a significant reduction in the cost of drilling rock. But only when you consider the cumulative effect of all these savings do you get the true picture of Carset economy. It is a picture that has already changed the entire concept of drilling costs — in mines, quarries, tunnels and construction jobs the country over.

✓ **CHECK THESE FOURTEEN SERVICE-PROVED SAVINGS!**
EACH ONE IS AN IMPORTANT FACTOR IN CUTTING COSTS PER TON OR YARD OF ROCK BROKEN

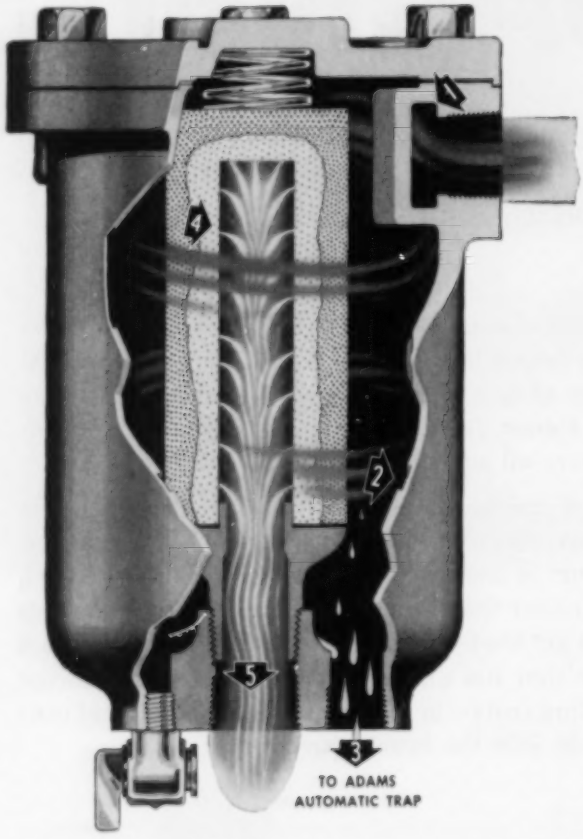
1. Carset Jackbits wear longer
2. Drill faster — 50% or more
3. Boost tonnage 20% or better
4. Consume less drill steel
5. Save up to 30% on dynamite
6. Practically eliminate bit changes
7. Use longer steels
8. Eliminate tapered holes
9. Permit use of lighter drills
10. Reduce air consumption at least 40%
11. Require less shop equipment
12. Reduce maintenance costs 30% or more
13. Drill the hardest rock
14. Finish more rounds per month

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N.Y. 565-15

ROCK DRILLS • COMPRESSORS • AIR TOOLS • TURBO-BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

ADAMS *has both* *



—— BOTH ANSWERS TO THE PROBLEM OF KEEPING WATER, WATER VAPOR, OIL AND DIRT OUT OF COMPRESSED AIR LINES

There's no *one* answer to this problem! The most expensive aftercooler you can buy will not remove scale that is picked up in the distribution lines. The most expensive air filter you can buy cannot guarantee removal of water vapor until it has been condensed by cooling. That's why Adams makes both.

* PORO-STONE *AIR FILTER*

1. Centrifugal separation of dirt and liquids.
2. Drainage to trap directed by vertical cast-in slots.
3. Continuous, fully automatic trap action.
4. Rapid diffusion and filtration through permanent, cleanable Poro-Stone.
5. Clean, dry air at practically unchanged pressure. Standard, stocked sizes handle from 10 to 700 cfm.

Easily installed in either vertical or horizontal pipe line.

* AFTERCOOLER AND CYCLONE SEPARATOR

Cools air to within a few degrees of cooling water, making certain that compressed air is colder than surrounding atmosphere, so that no further condensation can take place.

Counter flow, air-through-tube design assures continuously high heat transfer rate.

Double cyclonic action deposits all water and entrained oil in special moisture chamber.

R. P. ADAMS CO., INC.
209 E. Park Drive, Buffalo 17, New York

Please send me your latest literature, Bulletin No. 176 on BOTH the Poro-Stone air filter and the Adams Aftercooler — Cyclone Separator.

Name .....
Company ..... *Title* .....
Address ..... *State* .....

FOR YOUR PROFIT'S SAKE — FIND OUT ABOUT BOTH

R. P. ADAMS CO., INC., BUFFALO 17, N. Y.

BAD AIR IS COSTLY...

... as compared to the blower that keeps air fresh

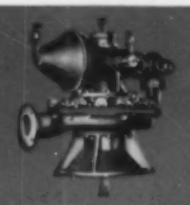
Your men can't produce at top efficiency when stagnant, hot or fume-filled air robs them of their energy.

Wherever bad air slows down production . . . in shipholds, tanks, drums, boilers or other places where men need fresh, cool air . . . a Coppus Blower becomes both a safety device and a production tool.

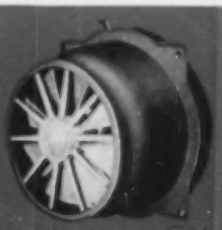
Portable and easily adaptable for special purposes, Coppus "Blue Ribbon" Blowers and Exhausters fit all your "fresh air" requirements. The Coppus "Blue Ribbon" means premium performance at ordinary cost. Check and mail the coupon for specific information. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, BEST'S SAFETY DIRECTORY, MINING CATALOGS.

OTHER COPPUS "BLUE RIBBON" PRODUCTS

HORIZONTAL TURBINE
Six frame sizes —
1 to 150 horsepower



VERTICAL TURBINE
Six frame sizes —
1 to 150 horsepower



FANMIX GAS BURNER

FANMIX OIL BURNER

MAIL THIS COUPON To Coppus Engineering Corp., 205 Park Avenue, Worcester 2, Mass.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets; etc., after treated with coating material.

NAME .....

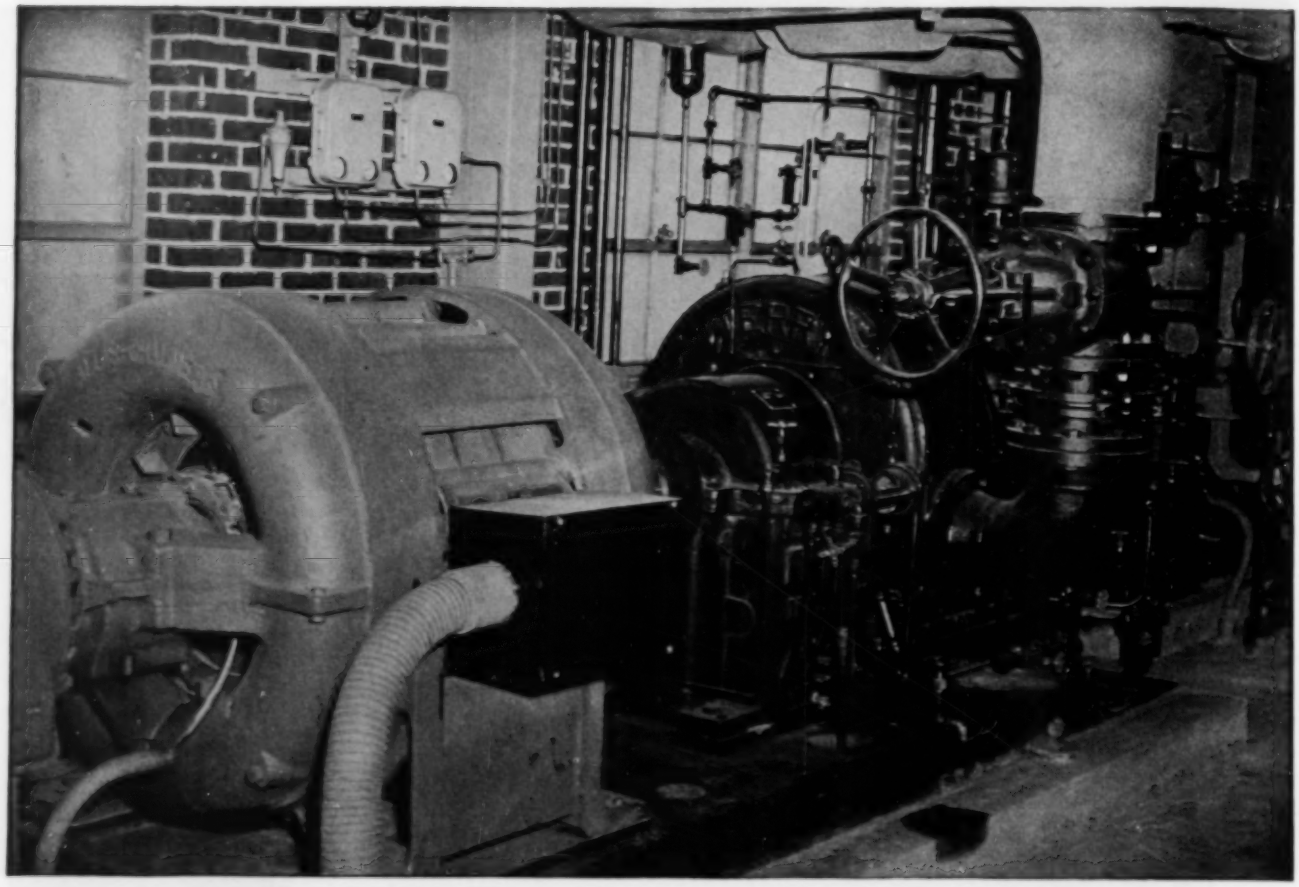
COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)

The TERRY TURBINE



For By-Product Power and Steam Balance

This 200 kw Terry Turbine driven generating unit operates in parallel with other generating equipment, the load on the unit being adjusted in accordance with the demands for exhaust steam. It is a single stage axial-flow, type, 4500/1200 rpm, 160 psi, 0 superheat, 5 psi back pressure, equipped with Terry reduction gears, oil-relay governor, motor synchronizer and back-pressure regulator.

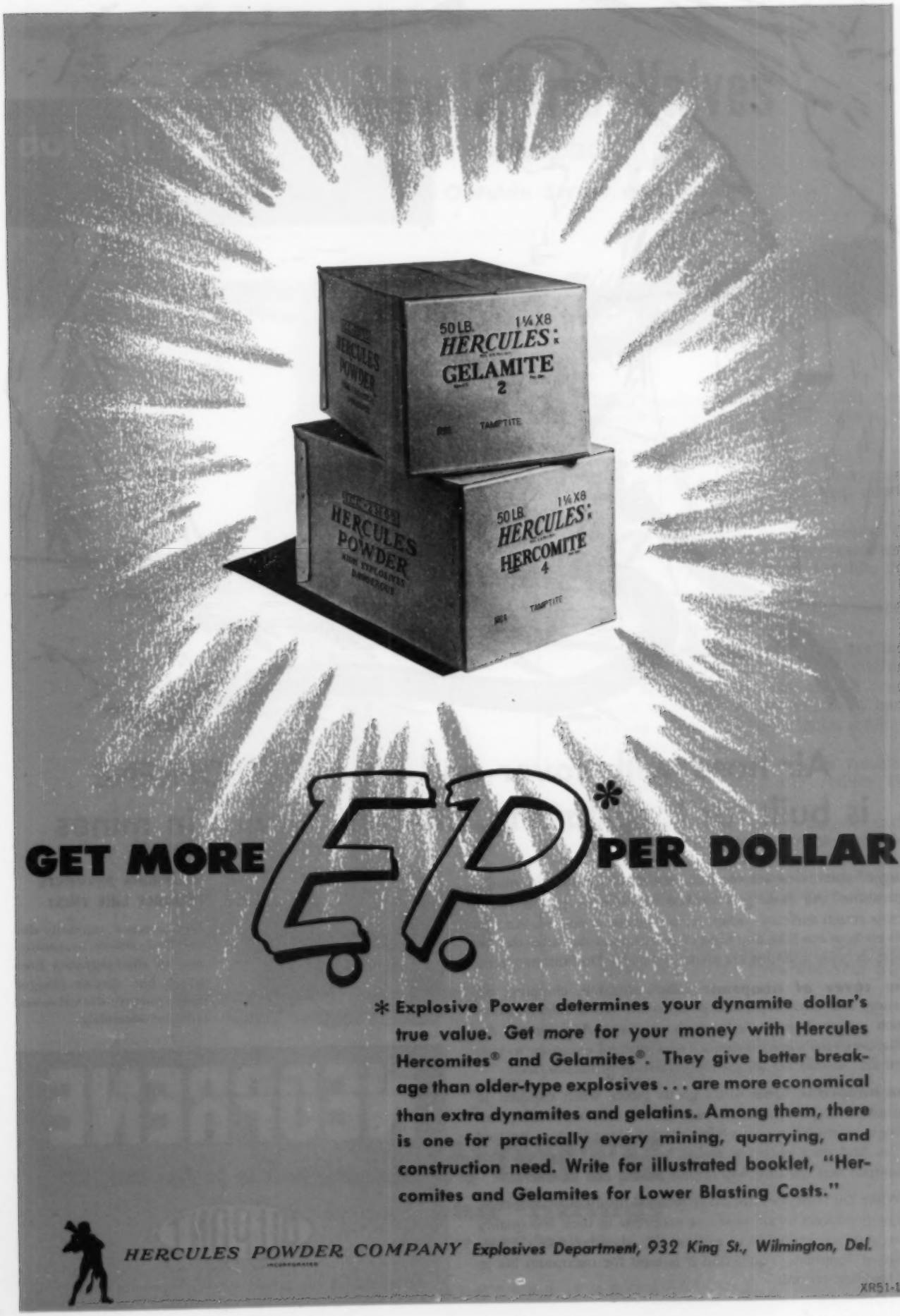
The installation pictured above is typical of many special applications of Terry Steam Turbines, each designed for specific requirements.

Any of our district representatives will gladly give you full information on a turbine to meet your requirements, no matter how special they may be.

No obligation, of course.

T-1176

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

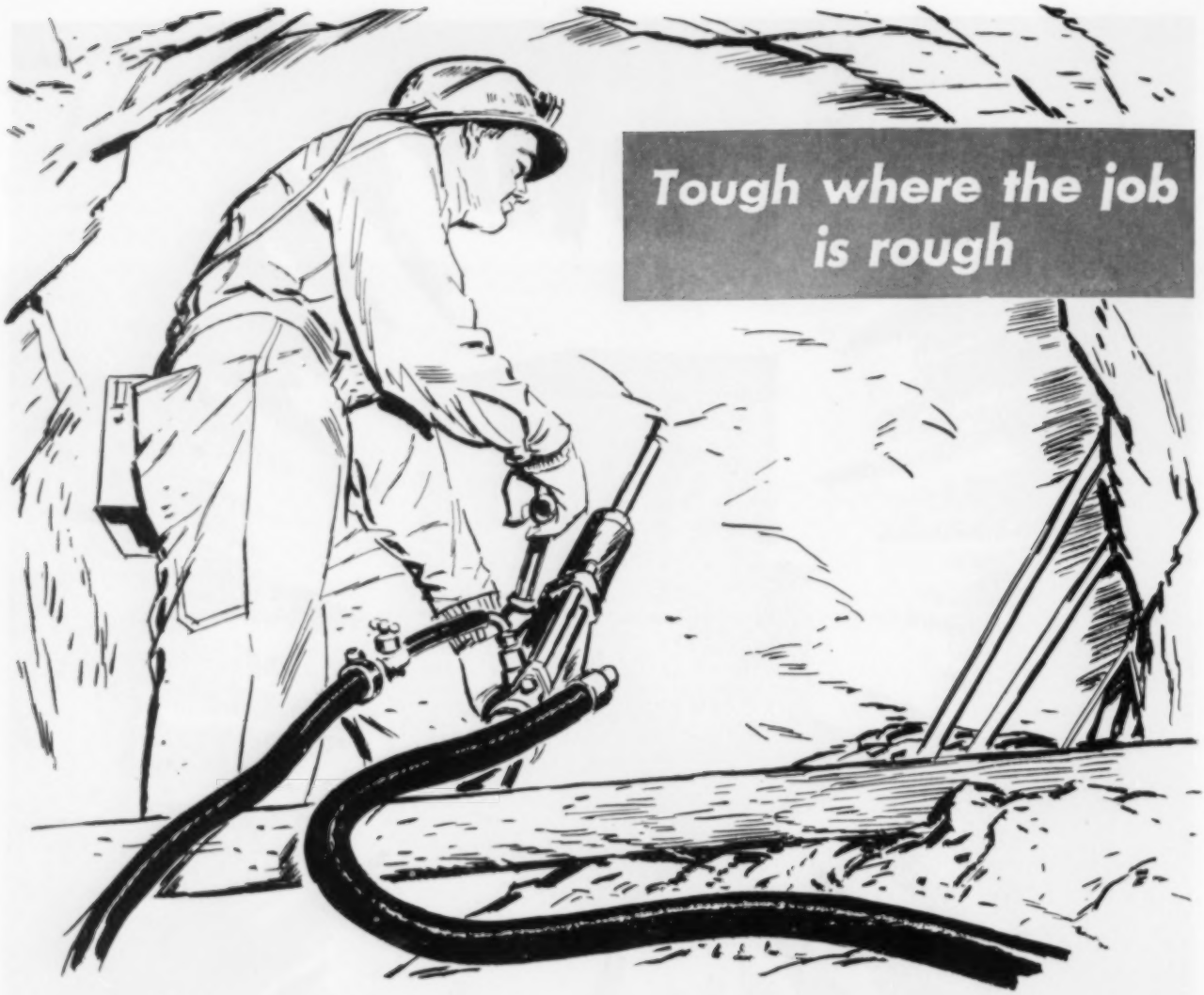


GET MORE E.P.* PER DOLLAR

* Explosive Power determines your dynamite dollar's true value. Get *more* for your money with Hercules Hercomites® and Gelamites®. They give better breakage than older-type explosives . . . are more economical than extra dynamites and gelatins. Among them, there is one for practically every mining, quarrying, and construction need. Write for illustrated booklet, "Hercomites and Gelamites for Lower Blasting Costs."

HERCULES POWDER COMPANY *Explosives Department, 932 King St., Wilmington, Del.*

XR51-1R



Air hose with cover and tube of NEOPRENE is built for long-lasting, efficient service in mines

Rugged conditions are the rule, not the exception in mining operations! Air hose gets yanked over sharp, jagged rocks, across rough surfaces—wherever air power is needed. And yet this air hose can take that kind of punishment day after day because its cover and tube are made of durable Du Pont neoprene.

The cover of neoprene resists abrasion, chipping, oil, cutting, and most acids and protects the fabric reinforcement much longer than an ordinary hose cover. And outside the mine, neoprene's unusual ability to withstand exposure to sunlight and weathering means longer-lasting protection too!

The neoprene tube won't go to pieces when exposed to hot lubricating oil in the air stream. This eliminates the possibility of crumbled particles being carried along to clog vital tool parts. And since neoprene resists heat as well, there's further assurance that the tube will remain strong and flexible.

While Du Pont does not make finished products of neoprene, major producers of air hose use neoprene in their top-quality lines. Ask your supplier to explain the advantages of air hose made of neoprene. You'll find it is built for maximum life in the toughest service.

NEOPRENE PREVENTS TROUBLE LIKE THIS!

Jackhammer, partially dismantled, shows accumulation of disintegrated hose which has almost clogged up air ports in the valve and rifle bar assembly.

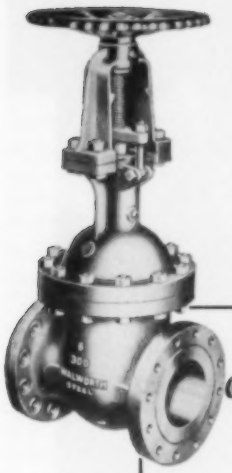
NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke

Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

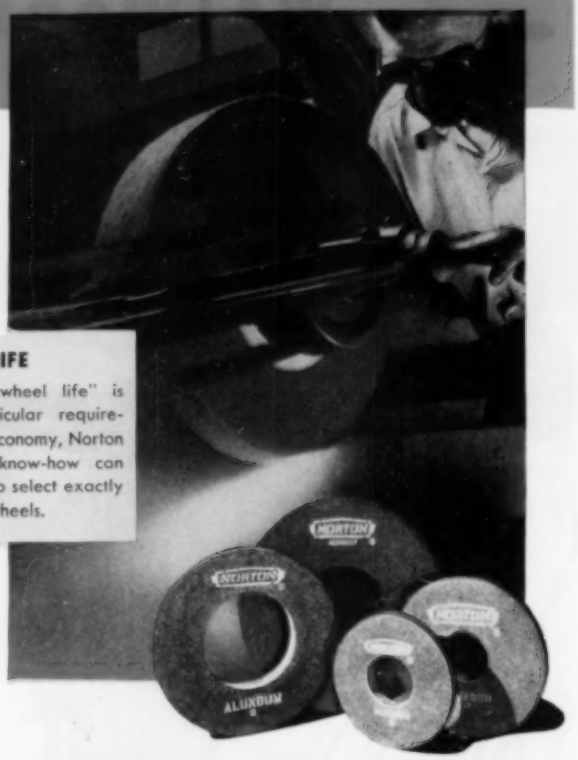
WOULDN'T YOU LIKE..

a wheel that would really snag off metal?

AND

last forever?

No such wheel has ever been made...



LONG LIFE

If "long wheel life" is your particular requirement for economy, Norton abrasive know-how can help you to select exactly the right wheels.

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ON THE COVER

A NEW method of supporting mine roofs replaces timber posts with bolts that actually bind the lowest exposed material to sounder rock above. It lends itself especially well to the conditions that prevail in coal mines, but is also being used increasingly in metal mines. As related in the article that starts on page 119, the scheme is making it possible to remove obstructing posts in an abandoned limestone mine near Pittsburgh, Pa., that is now a prosperous mushroom farm. With a large staff of girls at work there safety is of paramount consideration, and the bolts are consequently spot checked to make certain that they are tightly anchored in the overlying rock. Our cover picture shows hydraulic cylinders bearing against the roof and exerting a progressively increasing pull on a bolt. The pull is indicated on the gauge in the foreground and the bolt held fast until the force reached 21,000 pounds.

•

IN THIS ISSUE

PRIOR to last year, rust accumulation in lines and appliances was a leading cause of service calls received by Honolulu Gas Company. In 1949, there was evidence of products of corrosion or of water in 8500 of the 31,000 cases investigated. To remedy the situation, the gas is now dried before distribution by cooling it below the dew point. Economic cooling is obtained by using available exhaust steam to operate a steam-jet water-vapor refrigeration unit. Our leading article gives the particulars.

•

IF YOU are thinking of raising mushrooms for profit, look around for a deserted mine, preferably one that's spacious, dry, and of even temperature. Yoder Brothers set up business in a worked-out limestone deposit in western Pennsylvania and now harvest several tons of the flavorsome fungi daily. It's a fascinating business. Page 119.

•

IT SOMETIMES costs more and takes longer to remove concrete than it does to place it. This is invariably true if the concrete is in a wall of an industrial plant and the problem is to cut an opening through it to definite dimensions without disturbing surrounding structures and machinery. In a Pennsylvania factory, a contractor who was faced with performing a surgical job of this kind on especially resistant concrete overcame the difficulty by resorting to equipment and methods that are commonly used in metal mines. Page 123.

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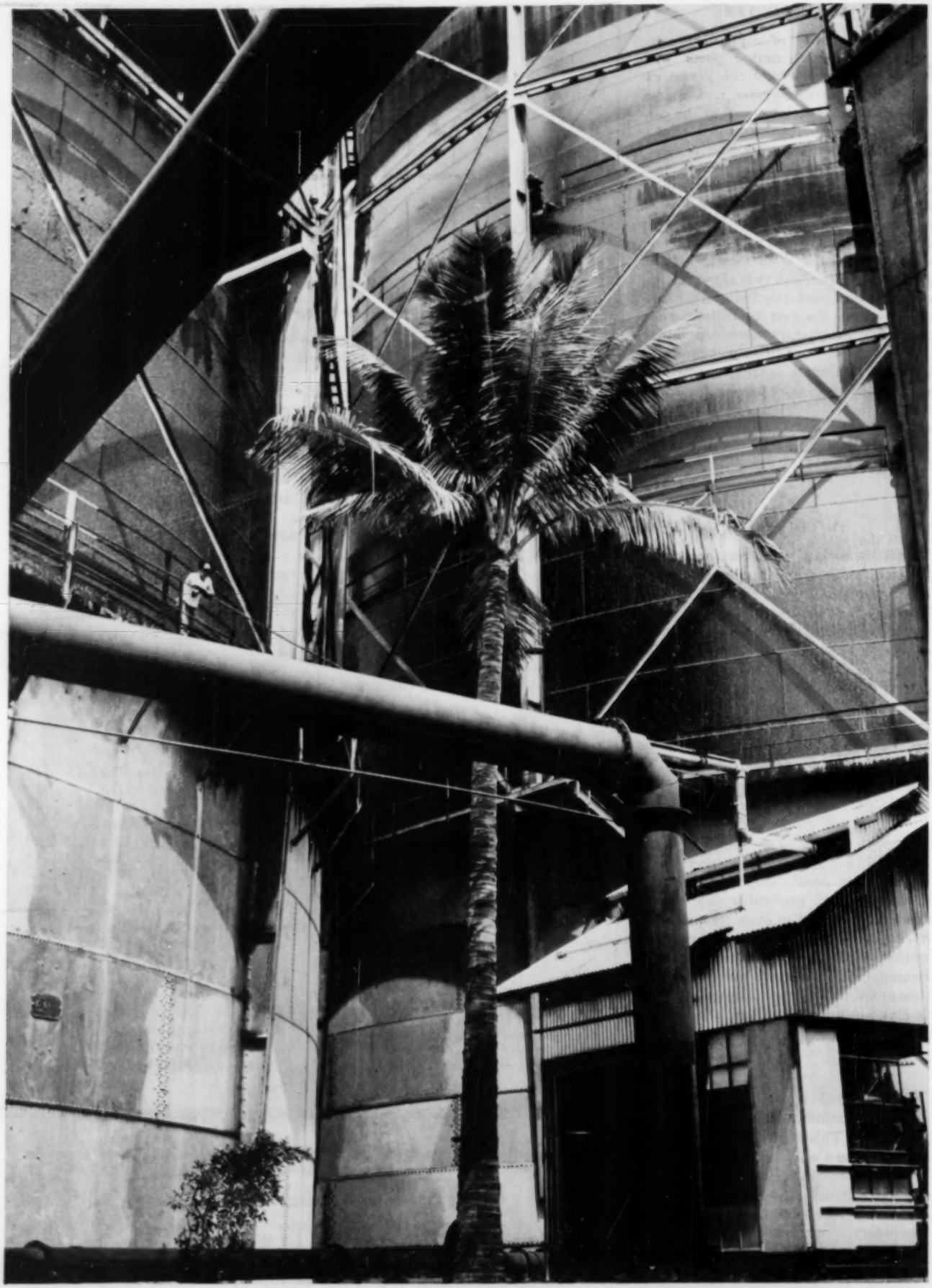
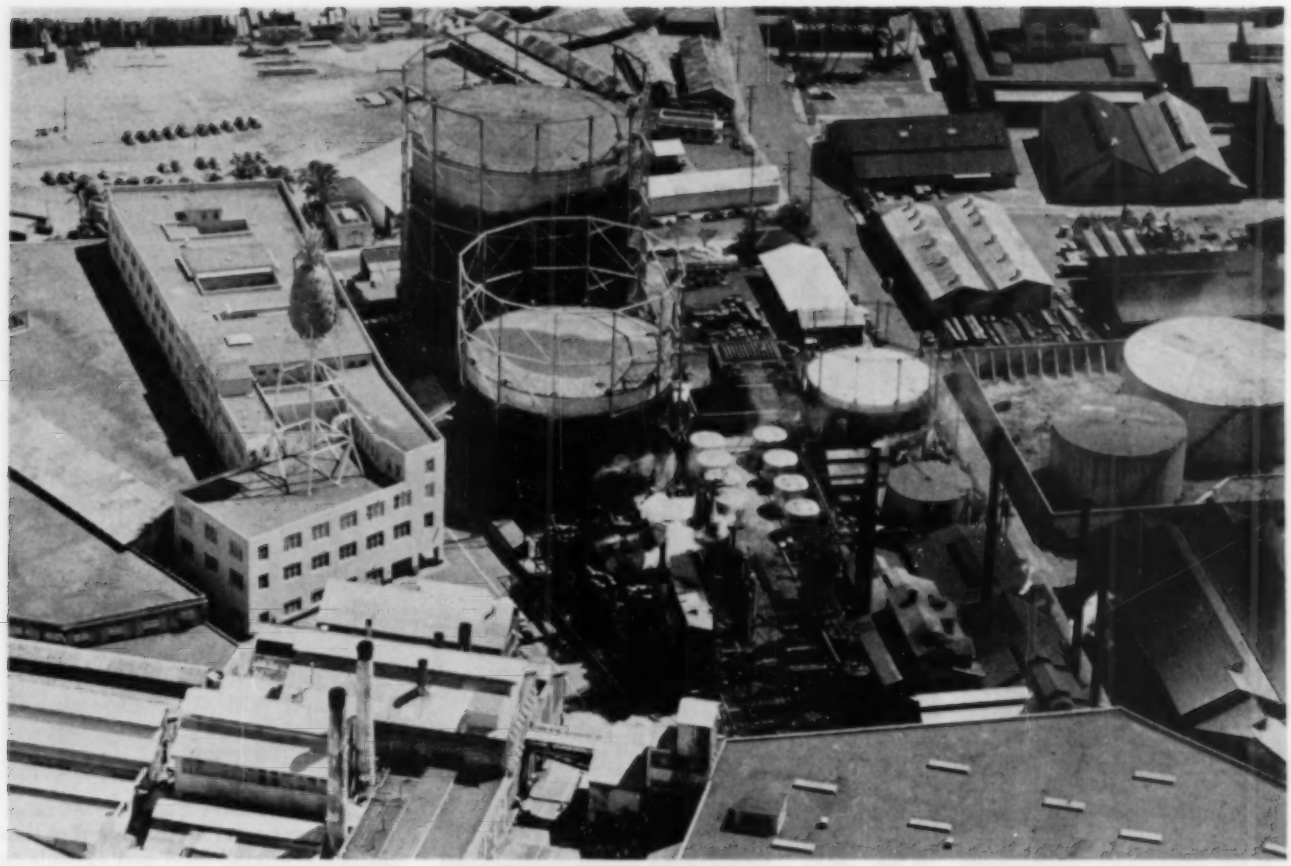


PALM TREE DEFIES INDUSTRIAL INTRUDERS

Perhaps no other gas plant includes palm-tree trimmings among routine maintenance facilities. The sturdy coconut palm, sandwiched between two gas holders of the Honolulu Gas Company, thrives amid its unusual surroundings.



FROM THE AIR

Nestled next to the cannery of the Hawaiian Pineapple Company, the Honolulu Gas Company's plant adjoins the world's largest pineapple. The latter, seen on the roof of the building at the left, is the cannery's water tower.

Cooling Gas to Thwart Corrosion

Honolulu Gas Company Uses Water-Vapor Refrigeration to Eliminate Moisture from Distribution System

Harold P. Saueressig*

GAS came to Honolulu 46 years ago because (according to one account) of W. R. Castle's memories of a childhood chore: keeping the woodbox full. Boys of the pioneer Castle family had regular tasks assigned them, and that one was his. When the stove was heated for a meal, Hawaii's normally balmy air turned torrid. In later years, Mr. Castle visited the mainland and saw cooking being done with a gas flame that was turned on the instant it was needed and off when cooking was done. That, he decided, was for Hawaii!

So in 1904 Mr. Castle organized the Honolulu Gas Company. The plant was completed in the following year, with 16 miles of piping to connect 250 gas users. Much of the first distribution system was "black" (coated) pipe laid in streets that had been sprinkled with salt water. Within two years the pipe "disappeared" and new lines had to be installed. Actually, however, the problem of pipe erosion has been found to be little different from that encountered on the United States mainland. The founder and first president headed the concern until his death in 1934. At that time there were about 15,000 customers and the gas mains had an aggregate length of 186 miles.

Ever since the day it began functioning, Honolulu Gas Company has kept steady pace with the rising population of this mid-Pacific city. Today the plant has three generators and can produce more than 8,000,000 cubic feet of gas a day. Last year it distributed 2,239,286,000 cubic feet, or about two and a half times as much as it did ten years ago.

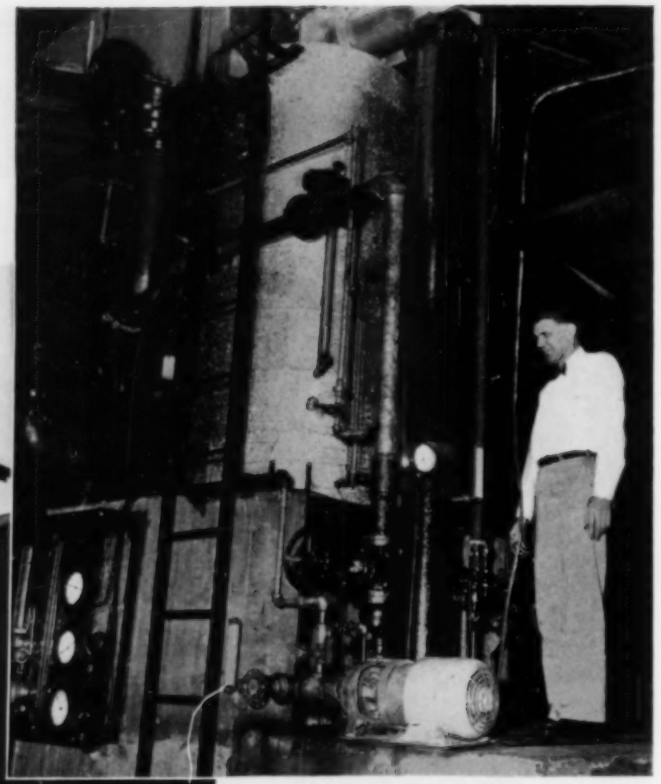
An element that has contributed to the continuing popularity of gas fuel in the community is the large oriental population which prefers to prepare many of its choice dishes over flames. The peak "send-out" is usually reached on December 31, for that is the day on which cooking is done for New Year's Day—the principal holiday of the older population of Japanese descent.

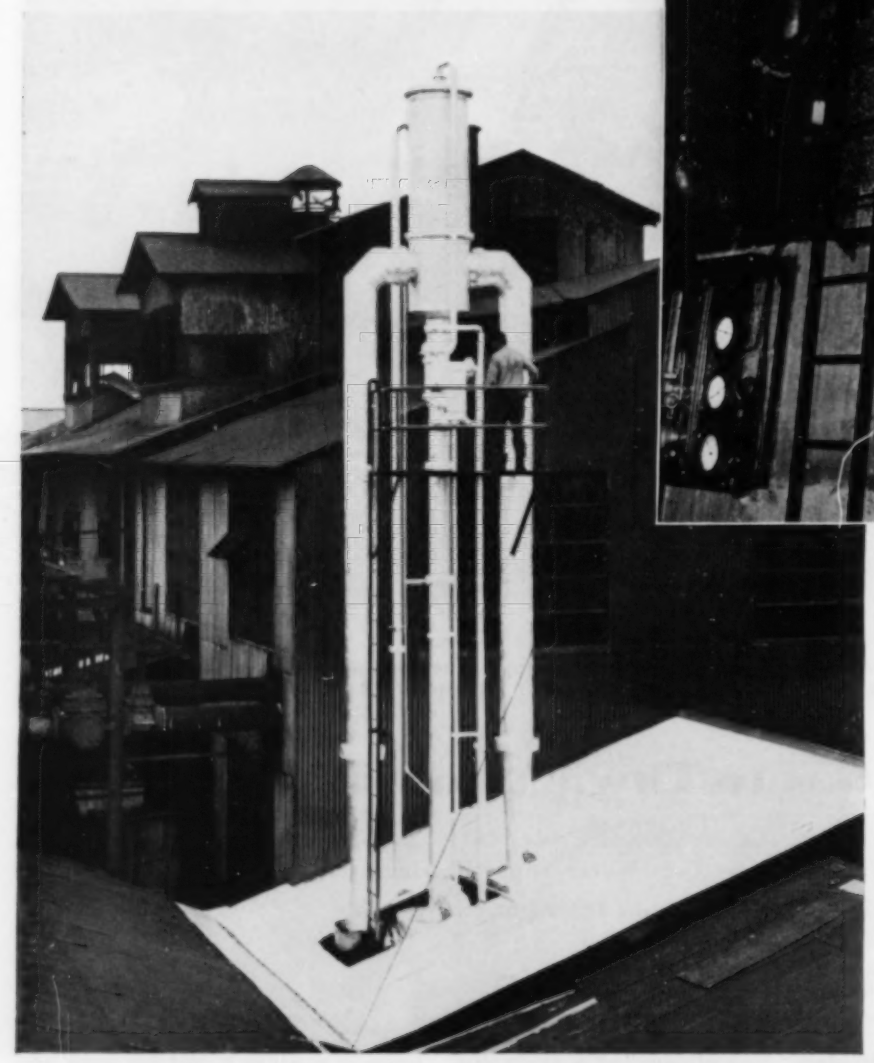
Honolulu Gas Company was formed during a period when the oil-gas industry was growing on the West Coast. However, increased distribution of natural gas in ensuing years eliminated many of the mainland stations which came into being at about the same time. Consequently, the Honolulu plant is now one of the few in the nation that deliver oil-gas exclusively, and it is considered to

*Formerly Plant Superintendent, Honolulu Gas Company

THROUGH THE ROOF

Because it includes a barometric condenser, the Ingersoll-Rand steam-jet water-vapor refrigeration unit is 51 feet high and its upper section extends through the roof of the Utility Building. However, it requires a floor space of only 6 feet 3 inches by 9 feet. At the right, Harold P. Saueressig, formerly the company's plant superintendent and author of this article, is looking over the lower part of the apparatus. At his feet is a 1½-hp. Motorpump that circulates chilled water through aftercoolers to cool the gas.





be one of the most efficient of its kind.

With about 300 employees and an annual payroll exceeding $1,000,000, Honolulu Gas Company is a major factor in the business life of the Hawaiian community. Currently, it manufactures and delivers daily around 6,500,000 cubic feet of 515-Btu. gas made from heavy fuel oil in modernized Jones-type generators and conventional auxiliary equipment. The maximum send-out pressure is 50 psi. The transmission and distribution systems are made up of about 270 miles of piping ranging in diameter from 2 to 12 inches.

A survey conducted in 1948 revealed stoppages in the distribution mains and customers' lines, regulators, meters, and appliances caused by iron-oxide dust resulting from corrosion. In 1949, as many as 31,000 complaints were received from the 36,000 consumers. Upon blowing the service lines, it was found that there was dust in 7600 of them and water in 1900. Combined, they represented about 26 percent of the lines investigated. In view of this finding it was decided to take steps to eliminate corrosion by reducing the moisture content of the gas sufficiently to prevent condensation in the distribution system.

Up to that time the gas that entered the transmission mains was being cooled to only approximately 90°F. by passing it through two conventional aftercoolers operating in parallel. Semibrackish water at 72°F. was used for this purpose and was discharged from the aftercoolers into a finger-coral formation that lies just below ground level and extends to the ocean. Being extremely porous, this material offered a convenient means of disposing of the once-through cooling water.

A survey of the city's soil temperatures showed minimum figures of 62° to 64°F. Plans were consequently made to provide facilities that would maintain the maximum gas dew point at 2° below the minimum ground temperature at the transmission and distribution pressures of 45 psig. and 20 psig., respectively. Since Honolulu atmospheric temperatures drop below ground temperatures only occasionally, it was believed that the latter could be considered the controlling factor in determining maximum permissible gas dew points.

After these conditions had been established, an investigation of the various means by which the gas might be dried indicated that cooling would be the most economical method for the moderate range required. This called for some kind of refrigeration equipment, and a steam-jet water-vapor unit was selected for the following reasons: exhaust steam was available at 10 psig. pressure; existing cooling-water systems could be easily altered to permit series flow through the refrigeration equipment; and apparatus of this type needed the least amount of floor space.

In order to utilize existing facilities and thereby keep down the investment, it was decided to retain the aftercoolers and use the refrigeration unit to supplement the work they were doing. Thus,

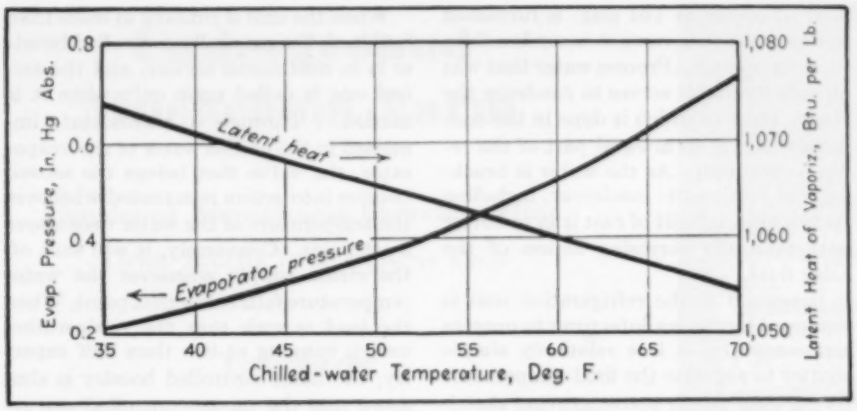


FIGURE 1- CHILLED-WATER TEMPERATURES

Chart at left shows how chilled-water temperatures decrease as the degree of vacuum in the evaporator increases and indicates how many Btu's of latent heat are removed per pound of water evaporated under varying conditions.

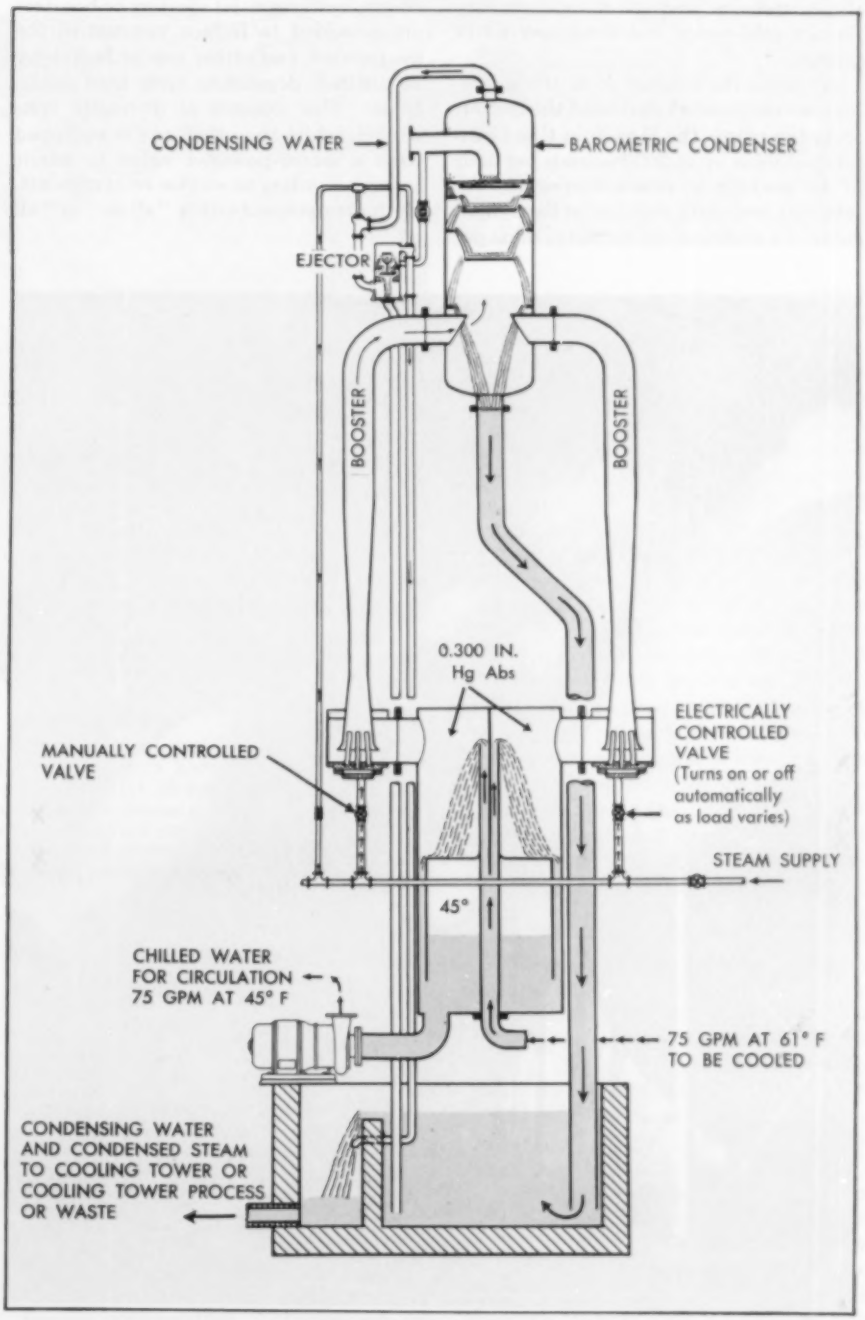
under the new arrangement, the old aftercoolers function as before to cool the gas with raw water to 90°F. and the new equipment completes cooling to the final temperature of 55° with chilled water that is circulated through two additional aftercoolers. This has the further desirable effect of limiting the load on the refrigeration system.

The steam-jet refrigeration equipment is of the Ingersoll-Rand type and has a rating of 60 frame tons, which means that it will produce 60 tons of refrigeration per day when cooling water to 50°F. As applied to the service concerned, it is designed to chill 75 gpm. of water to 45° and return it to the evaporator at 61.3°. The installation was completed in January, 1950, and tests conducted since then have shown that the capacity and performance requirements have been exceeded.

The working principle of steam-jet refrigeration units has been explained in these pages but will be reviewed briefly for the benefit of readers who are not familiar with it. The cycle is similar to that of a vapor-compression system using a chemical refrigerant, except that the physical properties of water are such as to keep the pressures involved below atmospheric pressure. A further difference is that the water evaporated to produce the refrigeration effect is not normally recirculated.

In a system of this type, water, the only refrigerant used, is introduced into an insulated chamber in which sufficient vacuum is maintained to cause some of it to evaporate. It is not possible for water to remain liquid if the pressure on it is reduced to less than its vapor pressure at the existing temperature, as shown in Figure 1. The latent heat for the water that evaporates is furnished by the remaining water, which is cooled in the process. Vacuum is maintained by a suitable combination of steam-jet ejectors and condensers. In the installation under discussion, the main condenser is of the barometric type.

Since each pound of water evaporated extracts in excess of 1000 Btu's of latent heat, a corresponding number of Btu's of sensible heat will be removed from the



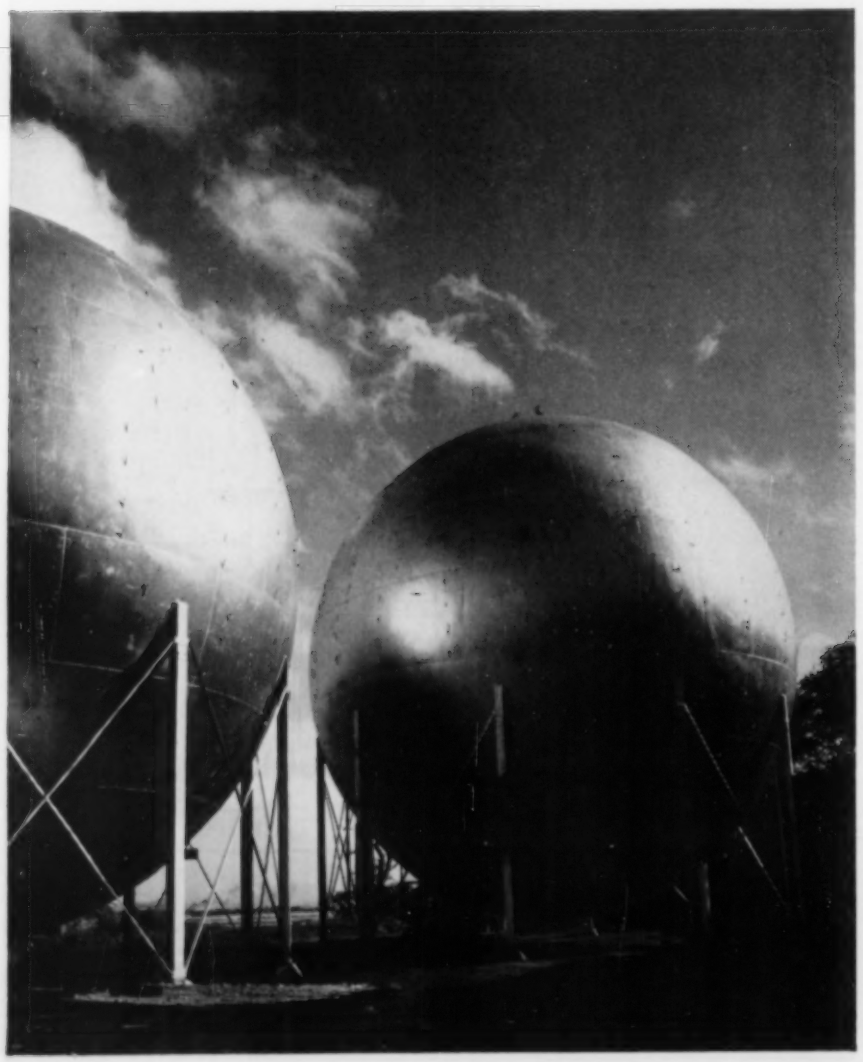
WORKING DIAGRAM OF WATER-VAPOR UNIT

One of the two boosters is always in operation, as shown. When the demand for chilled water increases, the second booster is brought into action automatically by control devices.

remaining water, which means that 100 pounds, for example, will be cooled approximately 10°F. Because each "ton" of refrigeration produced by any sort of refrigeration system means the extraction of 12,000 Btu's per hour, it is evident that the evaporation of slightly less than 12 pounds of water per hour is equivalent to one ton of refrigeration. The evaporator temperature maintained depends, of course, upon the vacuum maintained, and this, in turn, upon the work accomplished by the ejector-condenser installation. The only utilities required to operate such a system are steam for the ejectors, cooling water for the condensers, and steam or electricity for the cold-water and condenser-water pumps.

By using the exhaust from the steam-driven compressors that send the gas out from the plant, the Honolulu Gas Company obtains up to 2030 pounds per hour of steam at 5 psig. pressure to supply the jets that maintain vacuum in the evaporator. In addition, up to 200 pounds per hour of steam at 140 psig. is furnished the ejectors that remove incondensibles from the system. Process water that was already available serves to condense the steam, most of which is done in the condenser that is an integral part of the refrigeration unit. As the water is brackish, the barometric condenser, including its tail pipe, is built of cast iron to better withstand the corrosive action of the salty fluid.

Inasmuch as the refrigeration unit is equipped by the manufacturer to operate automatically, it is a relatively simple matter to regulate the final temperature of the gas. As an accompanying sketch shows, two steam-jet ejectors or boosters are provided to induce vacuum in the evaporator, and either one or both may be utilized, depending upon load conditions. One booster is manually controlled, while the other one is equipped with a motor-powered valve to admit steam according to service requirements. Both are operated either "all on" or "all off."



SPHERICAL STORAGE TANKS

Two of the four Hortonspheres stationed at outlying points to maintain supply and pressure in lines that are at considerable distances from the generating plant. This pair is located a few miles from Pearl Harbor.

When the unit is running at more than half load, the manually controlled booster is in continuous service, and the second one is called upon only when it is needed. Through a thermostat, immersed in the chilled water of the evaporator, the valve that brings the second booster into action is actuated whenever the temperature of the water rises above a set point. Conversely, it will shut off the steam supply whenever the water temperature falls below that point. When the load is such that the refrigeration unit is running at less than half capacity, the hand-controlled booster is shut down and the motor-controlled one remains in service. The temperature of the water can be maintained within 2°F. of the established point under any operating condition within the capacity of the unit.

Because the chilled water is returned to the evaporator after passing through the aftercoolers, the circuit is a closed one, except for the addition of enough water to the evaporator to compensate for that lost through evaporation and removal. The quantity supplied the aftercoolers is regulated by means of temperature controllers that have their indicating elements in the departing gas stream. It varies widely, inasmuch as the gas send-out per hour ranges from less than 100,000 cubic feet in the morning to around 500,000 cubic feet during the evening peak period.

It is expected that numerous economies and benefits will result from the supplemental cooling of the gas. A marked change in the character of the corrosion products removed from the mains was noticed soon after the new facilities were placed in operation. In some parts of the city, where the dust previously contained enough moisture to give it a damp appearance, it is now dry and can be easily blown out of the pipes. Also, water has virtually disappeared from service lines.

With moisture excluded from the mains, it will no longer be necessary to blow consumers' lines, as was the practice when the visit of a service man was requested. Neither will it be necessary regularly to check the 21 moisture drips located at various points in the distribution system. Consequently, worth-while savings in labor costs seem certain. Further, relations with customers will be improved because of a reduction in the frequency with which appliances will have to be adjusted, changes made in regulators and meters, and service men dispatched to attend to matters that have normally meant interrupting the gas supply.

The new facilities were designed and installed by engineers of the Honolulu Gas Company with the assistance of the Hawaiian Equipment Company, distributor for Ingersoll-Rand products in the islands.

Underground Mushroom Farm

Abandoned Pennsylvania Limestone Mine Yields Profits from Fungus Crop

Ted Slager

HARVESTING AND PACKING

Of the 200 employees 90 are girls who pick and pack the mushrooms. Three weeks after the planted trays are placed in the mine caverns harvesting begins and continues daily for about two months in which time each 30-foot-square tray yields 45 to 50 pounds. Because steady illumination is injurious to mushroom growth, the girls (right) wear miners' hard hats with small battery-powered globes mounted on them. Each day's mushroom crop is sorted and packed in boxes and baskets (below) for shipment to markets by airplane and refrigerated trucks.

NESTLED in the foothills of western Pennsylvania is an unusual farm—unusual in that it is not visible to the casual observer, that the crop is cultivated in absolute darkness, that the temperature is a constant 57°F. the year round, and that the product is picked before it is ripe. This farm is given over entirely to the growing of mushrooms and is located in miles of winding passages deep in an abandoned limestone mine.

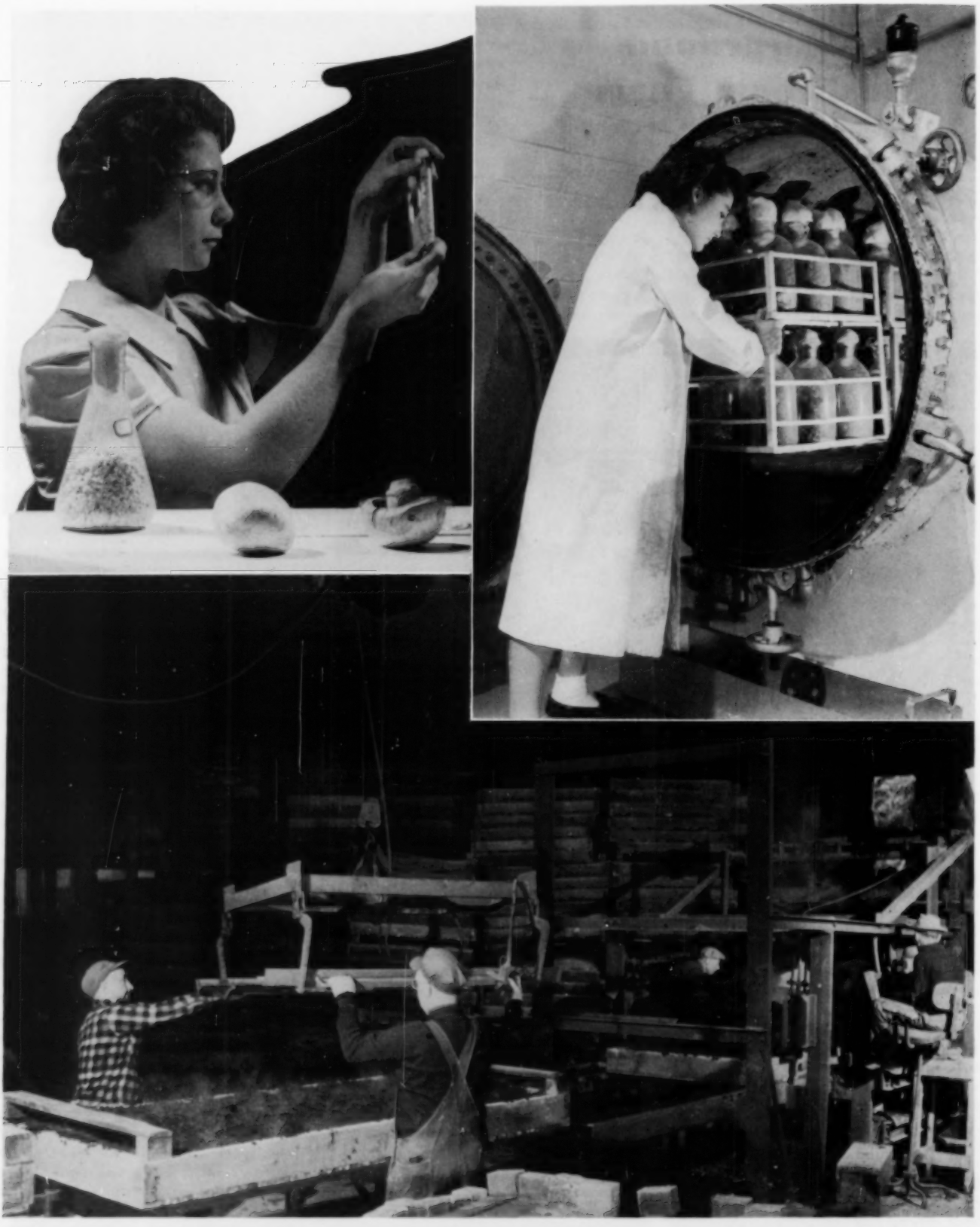
Mushrooms are a fungus and depend for their nourishment on organic substances derived from green plants. Unlike the latter, they are devoid of chlorophyl—green coloring matter—and are incapable of manufacturing from air, sunlight, and water the carbohydrate food they require. In fact sunlight, or continual light from any source, is deleterious, tends to discolor the crop, and the only illumination in the farm under consideration comes from gleaming electric torches. These are mounted on the regulation miners' hats worn by the harvesters.

About 300 species of wild mushrooms are found in the United States, but only one, the meadow mushroom (*agaricus campestris*), is grown commercially. Many are edible, but some are not and it takes an expert to distinguish the safe varieties from those that are unfit for human consumption. Mushrooms are rich in vitamin "B" and minerals, in fact, their mineral content is higher than that of most fruits and vegetables. Calorie-conscious persons know of their nonfattening properties and palatability. They are delicious in soup, or pan fried, stewed, or broiled, and are used to impart flavor and zest to bland foods. Once associated only with fine eating places, the fungus is no longer the luxury item it once was. More and more people are discovering that this tasty plant is inexpensive and easy to prepare.

A mushroom is made up of three parts: the mycelium or spawn, the fruiting body, and the spores. The mycelium might be likened to the roots of a green plant. It is the white thread-like member which extends into the soil and through which the fruiting body obtains its nourishment. The latter projects above the ground and consists of the stem, cap, and gills. It is from the gills of the mature mushroom that the microscopic spores or seeds fall when the fungus is ripe.

Cultivated mushrooms are generally picked while in the button or semimature state; that is, before the cap opens and exposes the gills or veil on the underside. While some consider the fully grown plant to be richer in flavor, it is the unripe crop that has the most sales appeal. Large mushrooms, some of which reach a diameter of 5 inches, are carefully culled out and used in the preparation of soups, sauces, and other canned delicacies.

It is only 50 years ago since two Pennsylvania flower growers brought the first mushroom spawn from England. Today, our total yearly production is well in excess of 70,000,000 pounds, and of this quantity Pennsylvania contributes one-half. Like many firms engaged in floriculture, Yoder Brothers, of Barberton, Ohio, cultivated the fungus as a by-



PREPARING FOR PLANTING

Spores collected from mature mushrooms are placed in sterilized tubes containing an agar solution (top-left). There they germinate to form the root-like mycelium, pieces of which are transplanted into flasks of rye grain. The product is used to inoculate progressively larger flasks and bottles until the quantity growing on the grain is sufficient for planting. Every precaution is taken throughout the process to prevent contamination. The flasks of grain are sterilized with live steam at 250°F. in a sealed chamber (top-right). Meanwhile the compost is being prepared with equal care. Mixed with organic materials and minerals to obtain the desired composition, it is cured for three weeks, sterilized with live steam for three days to kill unwanted matter such as insects and weeds, and put in trays. After the compost has cooled to 72°F. the mushroom spawn is planted. Three weeks later a thin layer of topsoil is added and the trays are hauled into the mine. The lower picture shows a tray about to be picked up by a carriage suspended from an air hoist.

product in its chrysanthemum greenhouses.

As demand for this highly nutritive food increased, the existing facilities became inadequate and the company sought a location that would permit large-scale production. They found it in a worked-out limestone mine at West Winfield, near Pittsburgh, Pa. It was ideal for the purpose, because the walls and roof were solid, chambers offered ample headroom (an average of 14 feet), and passageways were wide enough for trucks. But most important of all, the mine was dark, dry, and draft free, and its temperature was 57°F. the year round.

Operations were started in 1937 with the construction of a scientific laboratory, refrigerated rooms, a steam plant, and buildings for the treatment of compost. In the years that have elapsed since then, the project has expanded steadily, and now the farm, with its 50 acres of underground rooms, yields several tons of mushrooms daily. It employs about 200 people, 90 of whom are girls who pick the crop and pack it for shipment.

Manure for the beds or trays in which the spawn is planted aboveground is purchased in carload lots and comes from as far away as New Orleans, La. Other sources are famous race tracks at Lexington, Ky., Cleveland, Ohio, and Detroit, Mich. After being mixed with other organic substances such as straw, hay, corn fodder, or corn cobs and suitable chemicals, the compost is fermented, aerated, placed in the trays and pasteurized with live steam for three days. Pasteurization at a temperature of 135°F. conditions and cures the compost and kills any insects, weeds, and foreign molds that might have been introduced by the raw materials.

The spores are collected from mature mushrooms on sterile paper and are placed in test tubes containing an agar solution. There they develop until they are ready to be transplanted into flasks of sterilized rye grain for further germination. Inoculation continues in progressively larger flasks and bottles until the quantity of mycelium growing on the rye grain is sufficient for planting.

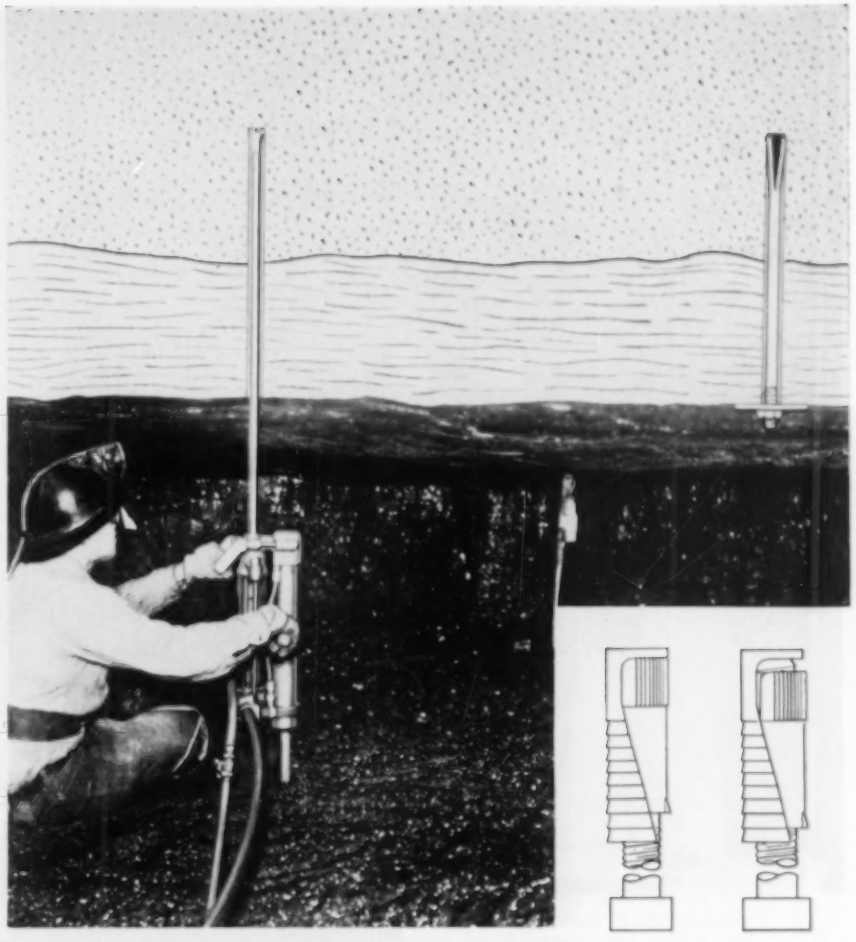
Three weeks after the beds have been fully prepared, the compost is covered with an inch of fine topsoil. Then the trays are loaded onto trailers and hauled into the mine. In three more weeks the mushrooms begin to pop up and are harvested every day for about two months. Each tray is 30 feet square and yields from 45 to 50 pounds. The spent compost is an excellent fertilizer and sold locally to nurserymen. Packed in small boxes or in baskets, the mushrooms are shipped daily by airplane and refrigerated trucks to markets in many states.

When the mine was in its legitimate business of excavating limestone, the roof of the extensive workings was held up by conventional mine timbers. While adequate from a safety standpoint, many of the uprights hampered the free movement of the trays. In an effort to overcome this difficulty, the mushroom farm sought the help of Ingersoll-Rand Company in devising some means of support that would permit removal of the obstructing timbers.

Field representatives were sent to investigate and suggested roof bolting which is being used in numerous coal and metal mines where conditions are favorable. While comparatively new so far as its general application is concerned, it has successfully served at least one large mine for twenty years. Briefly, it consists of an expansion-type bolt which is inserted into a hole drilled into the roof so that the bolt will penetrate deep into solid rock and, after tightening, anchor the roof firmly to the rock.

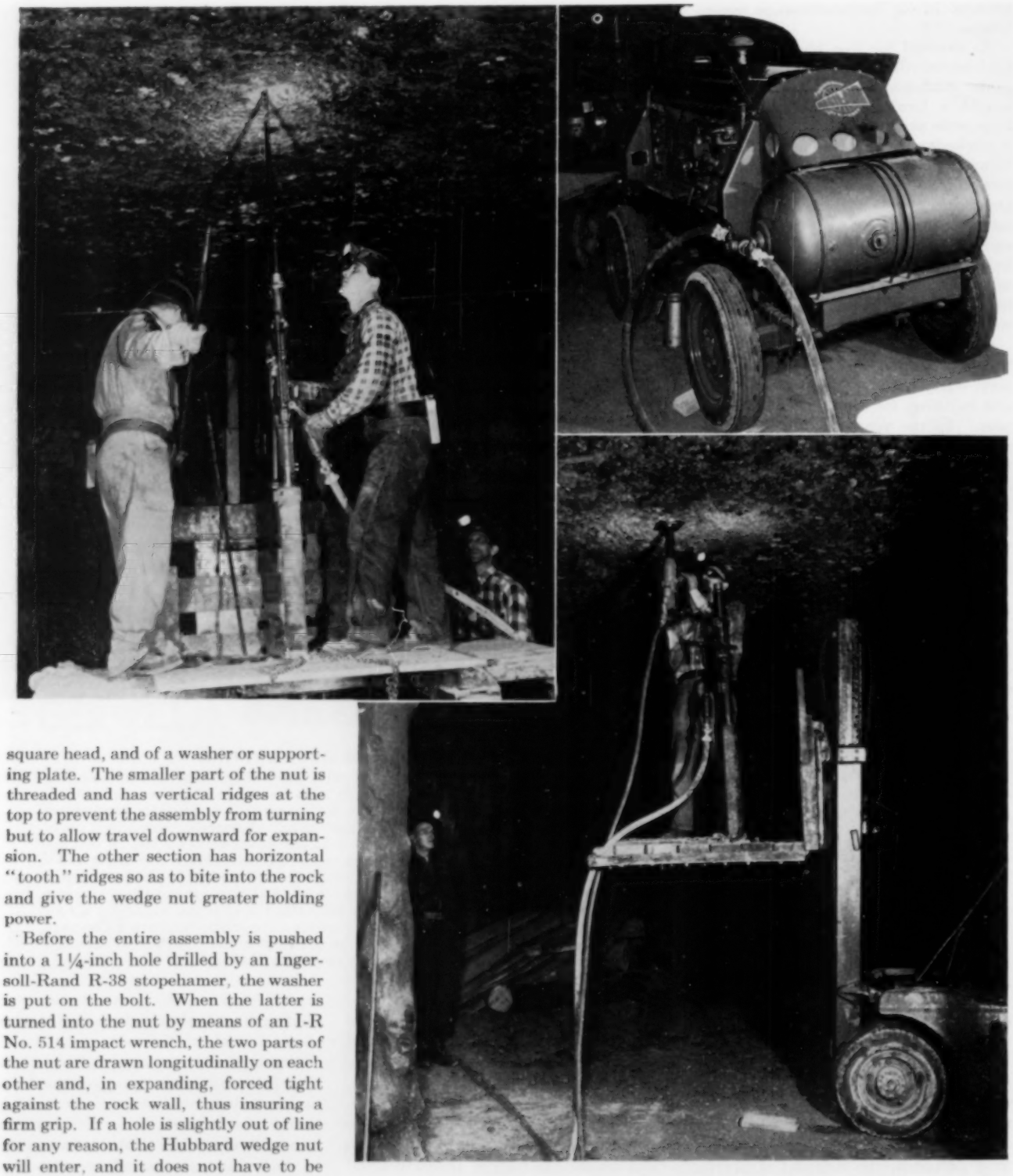
Authorities are generally agreed that the effect of roof bolting is to consolidate the immediate roof strata into a solid beam. In fact, it does several other things: it keeps the strata from sliding on the bedding planes and prevents any tendency of the roof to sag or deflect. Where friable rock is encountered, some operators utilize structural steel as cross members in combination with roof bolting. In that case, the bolts are first passed through holes drilled in the steel "I" beams or channels.

Roof bolts vary in diameter from ¾ inch to 1¼ inches. Those used on the Butler County mushroom farm are manufactured by Hubbard & Company of Pittsburgh, Pa. They are made up of a 2-part wedge nut, of a ¾-inch threaded bolt of any desired length with a full



PRINCIPLE OF ROOF BOLTING

To eliminate timber supports that were put in place when the mine was producing limestone and which now interfere with free movement of the mushroom trays the roof is being bolted to the rock above it. This system was introduced some years ago in coal mines, and the composite drawing and photograph show how it works. A vertical hole 1¼ inches in diameter is drilled, as shown at the left. A bolt that runs through a steel plate is then forced up into the hole (right). The upper end of the bolt pictured is divided and a wedge of steel inserted in it. As the wedge is driven against the rock it is forced down into the bolt, thus expanding and holding the latter securely in place. Although the method used in the mushroom mine is the same in principle, a patented 2-piece wedge nut made by Hubbard & Company, Pittsburgh, Pa., replaces the wedge. The drawings at the bottom-right show how the assembly expands when the bolt is screwed up into it.



square head, and of a washer or supporting plate. The smaller part of the nut is threaded and has vertical ridges at the top to prevent the assembly from turning but to allow travel downward for expansion. The other section has horizontal "tooth" ridges so as to bite into the rock and give the wedge nut greater holding power.

Before the entire assembly is pushed into a 1¼-inch hole drilled by an Ingersoll-Rand R-38 stopehamer, the washer is put on the bolt. When the latter is turned into the nut by means of an I-R No. 514 impact wrench, the two parts of the nut are drawn longitudinally on each other and, in expanding, forced tight against the rock wall, thus insuring a firm grip. If a hole is slightly out of line for any reason, the Hubbard wedge nut will enter, and it does not have to be shoved all the way into a hole to function properly. When in position and fully anchored, all that projects from the roof is the head of the bolt and the supporting plate. The air for the rock drill and impact wrench is furnished at the point of application by a 105-cfm. portable compressor that readily negotiates the underground passageways and eliminates the need of long air-hose connections.

PUTTING IN ROOF BOLTS

In the picture at the top-left a hole is being drilled in the mine roof with an R-38 stopehamer mounted on the platform of a high-lift truck. The bolt, which has a square nut on the lower end, is then shoved into the hole. As a final step in the operation, the nut is turned with a No. 514 air-operated impact wrench, as shown in the bottom view. This screws the threaded upper end of the bolt into the wedge nut and expands the latter so that it grips the rock firmly. Compressed air for these operations is furnished by an Ingersoll-Rand portable compressor (top-right) with a capacity of 105-cfm.

In order to determine the extent of the holding power of the wedge-nut roof bolting, engineers made tests in the mine by means of hydraulic jacks. It was found that the type resisted a pull of 21,000 pounds—that all the bolts tested remained in place. The company is therefore proceeding with the work and plans to support the roof throughout its entire 50-acre farm in the manner described.

COMPLETED OPENING

The opening in the background, with supporting steel framework in place, is 12 feet 4 inches high and 29 feet long. It was made in the 18-inch concrete wall by working from the interior of the building. After efforts to do the job with hand-held drills and paving breakers had failed, it was successfully completed by adopting tools and equipment long used by metal miners. Compressed air for this and another similar operation was supplied by an Ingersoll-Rand Mobilair compressor (right foreground) with a capacity of 315 cfm.

Concrete-Wall Surgery by Mining Methods

Pennsylvania Contractor Finds an Easy Way to Handle a Tough Building-Alteration Job

C. H. Vivian

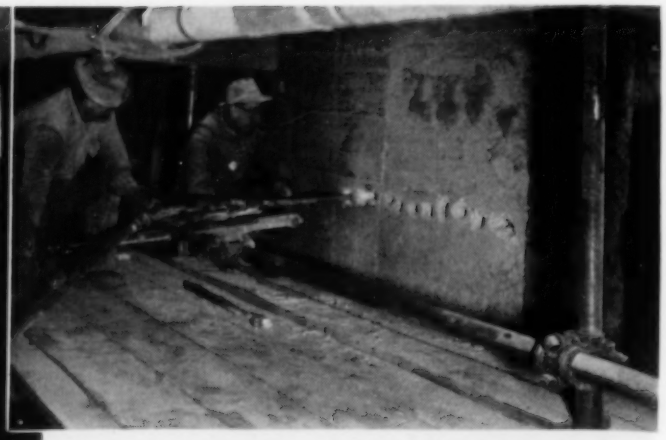
THE demolition of masonry or concrete structures ordinarily occasions little difficulty. Where conditions permit blasting, an entire building or any part of it can be toppled or broken up in short order. There are many situations, however, where dynamite can be used only sparingly or not at all, and then the operation becomes not only a tedious and time-consuming one but also costly.

Jobs of this kind are most often encountered in built-up metropolitan areas or inside industrial plants. Changes in factory layout sometimes make it necessary to take down a section of a wall or to cut an opening in it for a doorway or for some other purpose. Even then little trouble is experienced if the structure is of brick or stone because, once a small hole has been made, the adjoining units can be loosened and removed fairly easily.

Where concrete must be dealt with, the task becomes harder, and the difficulty mounts more or less in proportion to the thickness of the structure. A relatively thin wall can be pierced and broken out with chisels and hand hammers, although this is, at best, a slow way to do it. For faster work, the tools and technique employed by public utilities to open up paved city streets can be brought into play. A paving breaker will make a small initial opening, and the same tool can be used to enlarge it by chipping or breaking the material towards the hole, working continually outward.

Where concrete is so thick or unyielding that the latter method is too slow to be economical, practices akin to those followed by quarrymen must be resorted to. This calls for drilling rows of closely spaced holes, broaching the webs or ribs between them to form slots along the lines bounding the section to be removed, and then breaking out the intervening material.

Most industrial plants of appreciable size are occasionally faced with alteration jobs of this sort. Because of their nature they are necessarily time-consuming and expensive. In most instances, hand-held rock drills of the Jackhamer type and conventional paving breakers are utilized because maintenance departments are usually provided with them and are somewhat familiar with their use. Even when a contractor is called in, he generally employs these tools by reason of the fact that they are suitable for opening streets and work of a like nature



INITIAL OPERATIONS

These pictures illustrate the first step in the removal from a 24-inch-thick concrete wall a section 11 feet wide and 13 feet high. The view at the left shows two pneumatic columns or air legs supporting a crossbar on which was mounted a DA-30 drifter drill that powered the tools used to carry out this heavy-duty tailoring job on a building without interrupting operations. An air-supply hose can be seen at the base of each column. First a row of holes was drilled through the wall, as pictured at the right. After that work had been completed the material between adjacent holes was removed with a broaching tool to make a slot. Then the concrete between the slot and the ceiling was removed, a little at a time, by the plug-and-feather method, after which the lower section was taken out in the same way.

such as he is ordinarily required to do.

While machines and methods of this kind will get most jobs of this character done in time, much greater headway can be made by borrowing a leaf from the metal miner's notebook. This is especially true where thick and exceptionally hard concrete must be dealt with. In general, the drilling equipment involved is little different from that already mentioned. It is merely larger and more powerful and will, consequently, do more work in a given period. Moreover, it can be so mounted that it will be easier and safer to handle. When securely held, a drill or a broaching tool follows the desired line, thereby both increasing operating speed and insuring greater accuracy.

An instance where equipment of this type was used successfully after lighter tools had proved that they could not do the job within a reasonable length of time is found at the Easton, Pa., plant of C. K. Williams & Company, which makes paint pigments and allied products. In rearranging one of its manufacturing processes, the concern decided to make alterations in a 3-story building that would entail cutting openings at two places in a first-floor exterior wall of varying thickness. Because the structure is close to others and operations could not be interrupted even in the building concerned, it was impossible to use explosives.

The company was not equipped to handle the work, so it delegated the Easton contracting firm of Collins & Maxwell, Inc., to do it. One aperture, 29 feet long and 12 feet 4 inches high, had to be cut where the concrete wall was 18 inches thick; the other, roughly 11 feet wide and 13 feet high, at a point where it was 24 inches thick. The larger opening was tackled first and, not knowing the nature of the concrete, the contractor attempted to break it up with Jackhamers and paving breakers. It soon became evident that progress would be prohibitively slow with these tools. The wall, as it turned out, was composed of cyclopean concrete placed many years ago and the aggregates included chunks of discarded hard, blue grindstones that had been used in preparing pigments. These pieces had been added without sizing them and many weighed several pounds each. Reinforcing rods also were present in places, although they followed no distinct pattern.

After ineffectual efforts with the tools at hand, the contractor consulted an engineer of Ingersoll-Rand Company which manufactures rock drills and allied equipment at a factory in Phillipsburg, N. J., just across the Delaware River from Easton. The engineer visited the job and recommended changing to machines in service in metal mines throughout the world. The advice was followed, with the result that the tempo of the work picked up markedly and the operations were carried through to completion without encountering further difficulties.

As accompanying illustrations show, the scheme adopted consisted in drilling lines of holes, broaching the material between them to make slots, and breaking out adjoining sections of concrete by means of the plug-and-feather technique, a combination of methods regularly practiced in the mining and quarrying industries. The drill selected was a DA-30 drifter, a type that is widely found in mines but that contractors rarely use unless they are driving tunnels.

Because the DA-30 is too heavy (128 pounds) to hold by hand, some means of mounting it firmly had to be provided. At first glance, that might have offered difficulties, but the problem was easily solved by resorting to standard mining equipment. Well-nigh from the time mechanical drills were introduced, miners working in a drift or crosscut have set up a drifter drill on a horizontal arm attached to a vertical column extending from the floor to the roof and kept from turning by a footpiece that engages the rock.

Formerly, all columns, after they were put in position, were tightened by means of a screw arrangement to increase their length. In recent years a pneumatic column has been introduced that can be set up easier and quicker than the old type. It consists essentially of a length of 3-inch pipe in which a slightly smaller pipe serves as a piston and the outer end of which is closed to form a blunt point. By admitting compressed air to the bottom of the cylinder section of the upright column, the piston

is pushed against the roof, giving it a firm bearing. The bar supporting the drill is clamped to the 3-inch pipe and can be moved up or down, as may be desired.

As mine passageways are usually rather narrow, a short crossarm suffices and it is possible to obtain a secure mounting with one column. In the instance under discussion, where the concrete sections to be broken out were 11 and 29 feet wide, respectively, it would have been feasible to use a single column with a short arm and shift it frequently. However, for greater convenience, two columns were set up with a crossbar between them and supported at both ends. This arrangement permitted erecting scaffolding between the columns to get at the work. As the crossbar was 12 feet long, the drill could be moved along it for a distance of approximately 11 feet and the same width of wall covered before it was necessary to change the position of the scaffolding and the drill setup.

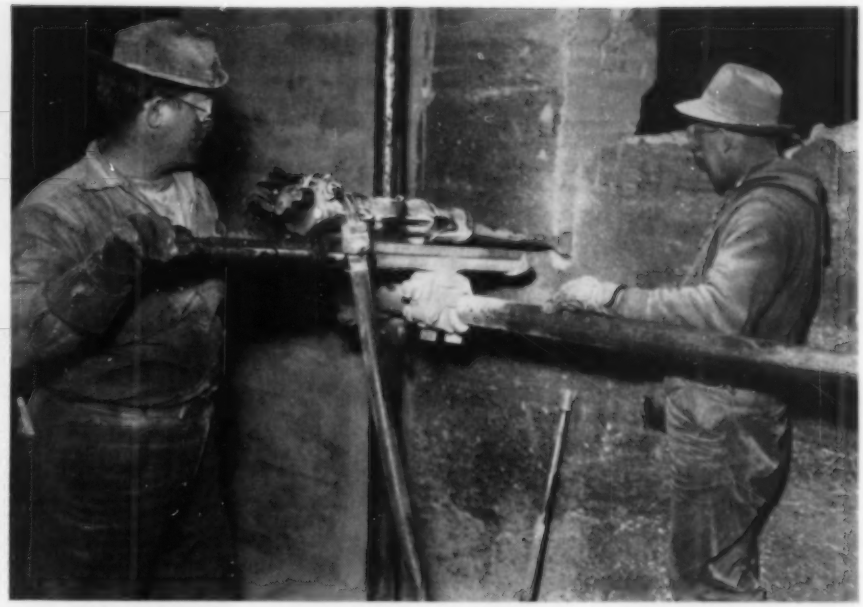
Operations were conducted from inside the building so that the floor and the ceiling, both of concrete, could be used as bearing points for the columns. Because the first opening was to be 29 feet wide and the heavy wall section above it had to be supported adequately, it was necessary to shore it up as concrete removal progressed. To do this, the work proceeded as follows: First, a 3-foot-long row of holes was drilled through the wall at one end of the top line, and the ribs between adjacent holes were broached to form a slot. From each end of the slot was drilled a vertical row of holes. After the latter had been carried down as far as possible without lowering the scaffold, the material between those holes was broached to provide slots.

The section of concrete thus outlined was then broken out, a little at a time. This was done by drilling a single hole through the wall at a point about 12 inches below the top slot. Two metal shims or feathers were then inserted in the hole and a chisel driven between them, the gradually increasing pressure thus exerted cracking the concrete so that a section of it could be pushed free. This procedure was carried progressively downward, the exact position of the hole at each step being governed by the upper contour of the wall remaining in place. Sometimes two holes were required in the same horizontal line to break the material out to the edges. In the beginning the plug or chisel was forced between the feathers by hand hammering, but the contractor decided that it could be done easier and quicker by the DA-30 drill. Accordingly, a suitable chisel was made from a length of regular drill steel. Lugs were omitted from the shank end so that the member could be powered but not rotated by the drill.

After a section of the wall had been cut away down to the platform of the scaffold, the latter was lowered a few feet and the same process repeated. When the work had been carried down to within 5 or 6 feet of the floor, the scaffold was removed, permitting the crew to break out the remainder of the concrete from ground level. Upon completion of these initial operations, there was an opening 3 feet wide and 12 feet 4 inches high in the wall. Similar longitudinal strips were then taken out in the center and at the opposite end of the area involved, thus providing spaces for setting up steel posts. Next, steel shoring was placed underneath a girder in the room's ceiling that was tied into the section of the outer wall on which the men were working and that met it at right angles.

With the load transferred, the concrete between the vertical openings was broken out by the procedure already described. As soon as the upper 2 feet or so of both sections had been removed, a permanent steel beam was put in place and supported at both ends and in the middle by the steel uprights that had been erected. With the overhead wall thus securely supported, the shoring was taken down and the wall sections that remained standing were broken up and cleared away.

As openings in mines are ordinarily lower than the one on this job, the longest standard pneumatic column avail-



BROACHING

This well-known method of quarrying blocks of dimensional stone was adopted to cut openings along the exact lines desired. Here the broaching tool is completing a slot made by breaking out the webs or ribs between adjacent holes drilled close together in a row. The smooth, even surface of the cut made in this manner can be seen on the wall section above the slot.

GROUP OF TOOLS

From left to right: A drill rod with a Carset bit attached; a plug with the companion steel feathers flanking it; and a broaching steel. Both the plug and the broaching tool were forged on regular drill steel to permit powering them with the drifter drill. Lugs were left off their shank ends so that they would not engage the rotation mechanism of the drill.

PLUG-AND-FEATHER OPERATION

These pictures show how the concrete was broken out in pieces sized for convenient handling after a slot had been made on each side by drilling and broaching. In the view at the right a hole is being started at a point about 12 inches below the top of the remaining concrete and about 2 feet from the left edge of the section to be taken out. After the hole had penetrated the 24-inch wall, two steel shims or "feathers" were put in it and a chisel-like plug was inserted between them and driven in with the drill, as shown below. The pressure thus exerted fractured and loosened a good-sized chunk of concrete (bottom-right). The detached piece was pushed off to the other side of the wall for loading and disposal.

able had an 8-foot cylinder and a 6-foot-4-inch piston, giving it an over-all length of 12 feet 4 inches when fully extended. With timber blocking under the foot-piece to give a better grip than that offered by concrete, the length was sufficient for the purpose. However, the clamps for connecting the crossbar are made to fit the 3-inch cylinder section, and as the latter reaches only 8 feet from the floor when in normal operating position, some other provision had to be made when working near the top of the wall. This problem was solved by simply reversing the column, placing the foot-piece at the top and the piston end at the bottom. This meant that the weight of the crossbar and drill had to be borne by the air pressure that extends the piston. Although the equipment is not designed to operate in this position, no trouble was experienced.

The smaller section, which was only 11 feet across, was removed by working clear across the wall at one time. That was possible because it was not wide enough to require supports. As the height of the section to be taken out exceeded the length of the pneumatic columns, timbers were placed underneath them to make up for the difference in elevation.

With the exception of the broaches and the plug-and-feather chisels, all the equipment furnished for the job was of standard manufacture. The broaching tool used in quarries is made up from flat stock and was not suitable in this case because the contractor wanted to operate the tool in the DA-30 drifter. Accordingly, it was made up from drill steel, like the chisels. The broach had a wide V-shaped notch on its working face. This was obtained by first forming the end of the steel into a ball and then forging it in a standard drill-steel sharpener by reversing the dies that are used in making moil-point steels for paving breakers.

Carset (tungsten-carbide-insert) detachable bits of 1¾-inch gauge on 1¼-inch hollow-round drill rods did all the drilling and penetrated the hard concrete at a fast rate. Holes were spaced so as to leave a web averaging 1¼ inches between them. As the broach face was 2 inches wide, the intervening material could be readily cut out. Compressed air was supplied by an Ingersoll-Rand "Mobilair" (portable) compressor of 315-cfm. capacity.

Upon completion of the job, Henry Maxwell, a member of the contracting firm, summed up the results as follows: "Altogether we removed approximately 350 square feet of 18-inch and 150 square feet of 24-inch concrete wall. The concrete was extremely hard and much of it in difficult places to get at. By using the tools that were recommended to us, especially the horizontal drill support held in place by two air jacks, the job was greatly simplified and also expedited."

Staley Air Systems Can Convey 175 Tons Hourly

ONE of the largest processors of corn and soybeans, A. E. Staley Manufacturing Company, makes extensive use of pneumatic systems for conveying different kinds of materials in its Decatur, Ill., factory. Within the confines of the 400-acre plant site is a total of 6500 feet of lines of this type with a combined carrying capacity of 175 tons an hour, or 4200 tons a day. The list of materials handled includes starch, soybean meal and cake, spray-dried syrups, corn germs, wet bran, corn-gluten and corn-oil meal, corn-gluten feed, and lime. Company engineers, who have become specialists in air-borne transportation, believe that they could, if need be, develop air-actuated systems for moving whole corn and soybeans.

As described in the February issue of *Food Industries* by Edwin O. Crawford, Staley project engineer, each of the numerous units is designed for the particular service it performs. Whenever a specific conveying job arises, the Staley staff, with the knowledge acquired through the years, can soon determine whether it can best be handled by mechanical or pneumatic facilities. If conditions favor the latter, it draws upon past experience in deciding upon pressure, size of pipe, and method of feeding.

Feeders vary with the system pressures used. Contributing greatly to the success of low-pressure transportation through large piping is a vibratory feeder that was developed by Staley technicians. It incorporates a baffle that prevents air from backing out of the line. Material is ordinarily supplied to the feeder from an overhead hopper with a double-paddle switch arrangement that keeps the level of the material so high that the air pressure is sealed in the line.

Systems in use cover a wide range. Most of them are operated by both pressure and suction; one uses pressure alone. Fans, centrifugal and positive-pressure blowers, or compressed air from the plant distribution lines serve as motive power, depending upon the pressures desired. The decision as to which is best suited for a given purpose is based upon such factors as quantity and kind of material involved, tendency of the material to clog lines, power requirement at various pressures, etc. In general, it is easier to feed material into a suction system, but if leakage develops it may be hard to find, whereas leaks in a pressure system make themselves known immediately.

Line stoppages are less frequent in a high- than in a low-pressure conveyor because it tends to clear itself. Further, it makes it possible to move materials longer distances. Where low pressures are used materials have a tendency to settle in and choke horizontal pipe sections. Because it may take several hours to get rid of an obstruction, two automatic signals have been devised to give instant warning and to shut down the unit before the trouble becomes serious.

The longest individual system is a 5-inch line that conveys ground starch a distance of 400 feet. It is pressure operated and moves 11 tons per hour with 489 cfm. of air at 20 psi., or about 1 cubic foot per pound. Feeding is done with a screw-type pump, which not only prevents leakage and blowback but also has been found to be the most satisfactory device for feeding starch.

Intermediate-pressure systems are powered by positive-displacement blowers, and the work is done by either pressure or suction. Around 5 cubic feet of air is required for each pound of material carried, including soybean meal and cake, lime, wet bran, and corn germs. Units using still lower pressures are provided with centrifugal blowers operating at 3600 rpm. These systems transport spray-dried syrups, starches, and soybean meal and their air requirements run around 15-20 cubic feet for each pound of material handled. The lowest-pressure lines have centrifugal blowers operating at 2300 rpm., or fan-type blowers. There the air consumption is about 30 cubic feet per pound of material, consisting of corn-gluten feed and corn-gluten meal.

SIDETRACKS REJECTS

Automatic in its operation, this Sheffield machine gauges and segregates ceramic protector blocks with carbon inserts used in telephone equipment. The parts are loaded manually into a magazine-type feed and are cleaned by a blast of compressed air as they move down the chute. Airlectric and Electricheck heads are used to do the gauging, and a light panel gives the operator visual indication of the results of each dimensional and load check. Rejects go into "Maximum" and "Minimum" chutes, while parts that pass all gauging stations are indexed to another chute from which an endless belt conveyor carries them out of the machine. The latter is designed for rapid changeover and setup for different blocks and can check up to 3600 an hour.

Three systems, two of 18-inch and one of 34-inch diameter, extend 300 feet from the corn-oil house to the feed-packing house. One of the 18-inch lines carries corn-oil meal and the other corn-gluten meal, both of which weigh 40 pounds per cubic foot. They are moved at the rate of 75 pounds per minute and at a speed of 5000 feet per minute. The 34-inch system, which is the largest in the establishment, transports corn-gluten feed (weight, 48 pounds per cubic foot) and handles 700 pounds per minute at a velocity of 6000 feet per minute. All three work at the lowest pressure used in the plant and are powered by fans running at 2300 rpm.

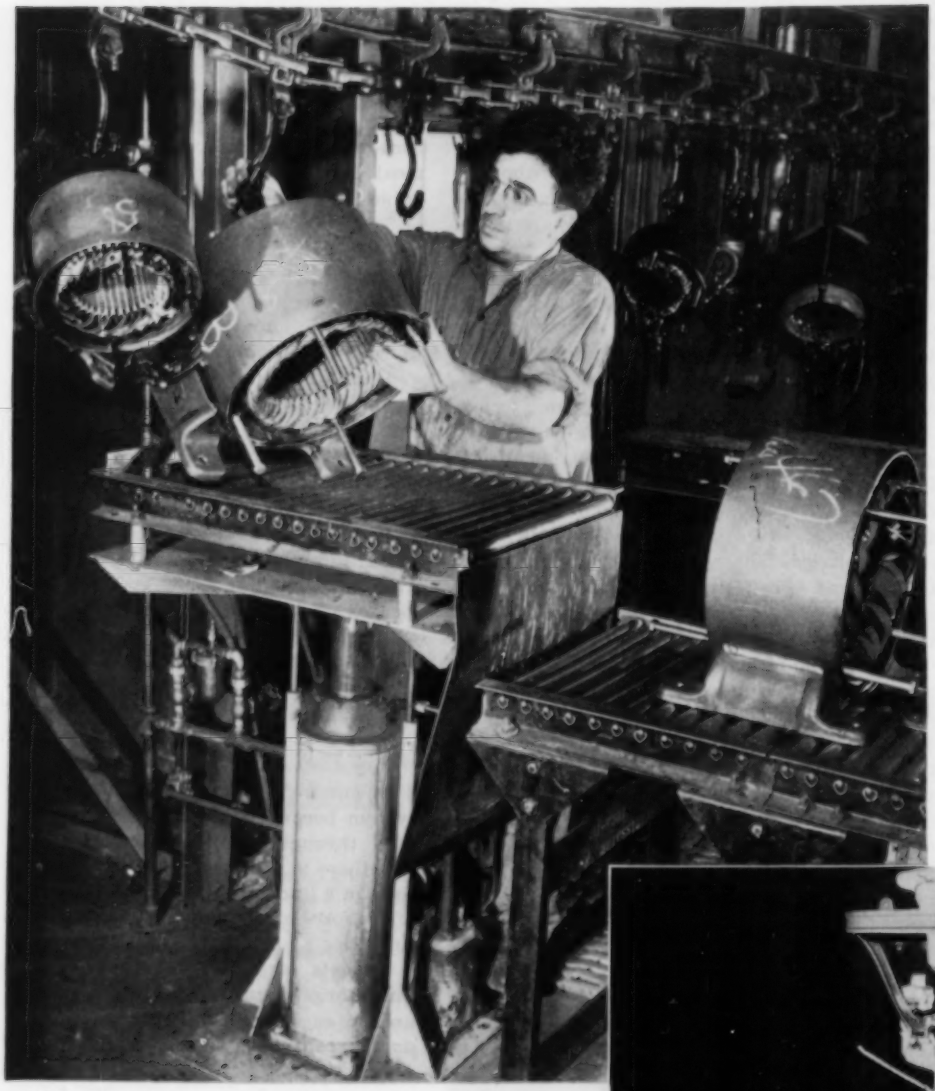
Lime and reprocessed feed are unloaded from boxcars at the rate of 10 tons an hour and conveyed 250 feet through a 5-inch line. This system is operated by suction induced by a 60-hp. exhauster located on top of the 3-story building to which the materials are delivered. The feed end is a hose attachment that is shifted around like a vacuum cleaner.

The longest vertical line carries soybean meal straight up six floors. Vertical transportation is the least troublesome in pneumatic conveying regardless of the system because the material is distributed throughout the entire pipe area and there is far less chance of clogging than in a horizontal line where, because of the force of gravity, it has a tendency to settle.

Staley's experience indicates that pneumatic systems generally cost less and are easier to install than mechanical ones, excepting extremely short sections, either horizontal or vertical. Maintenance costs also are normally lower. Where there are bends in the line, an air conveyor usually functions better than a mechanical one, which is favored for short, straight sections. As regards ease of operation, high-pressure pneumatic systems require least attention, but low-pressure units need more watching than mechanical ones.

Where dust is an important factor, it is necessary to provide air lines with collectors, and there is a point of dust incidence beyond which mechanical conveyors are preferable. On the score of sanitation, air systems are apt to be the choice because they tend to keep themselves clean—have no corners or pockets where accumulations can build up. Some moisture-bearing materials are too wet for pneumatic conveying, but no general rules can be laid down and each must be considered separately. Where delicate material is being conveyed and breakage of the particles is objectionable, mechanical systems are favored.

Compressed Air at Work



The air lift shown above is at the end of a roller-conveyor assembly line on which stators for Life-Line motors are made up in the Buffalo, N. Y., plant of Westinghouse Electric Corporation. As each wound stator reaches the terminal point, the lift elevates it so that it can be hooked onto an overhead chain conveyor. It eliminates physical exertion on the part of the operator, who controls the lift with a foot valve and thus has both hands free to maneuver the stator into hooking position.

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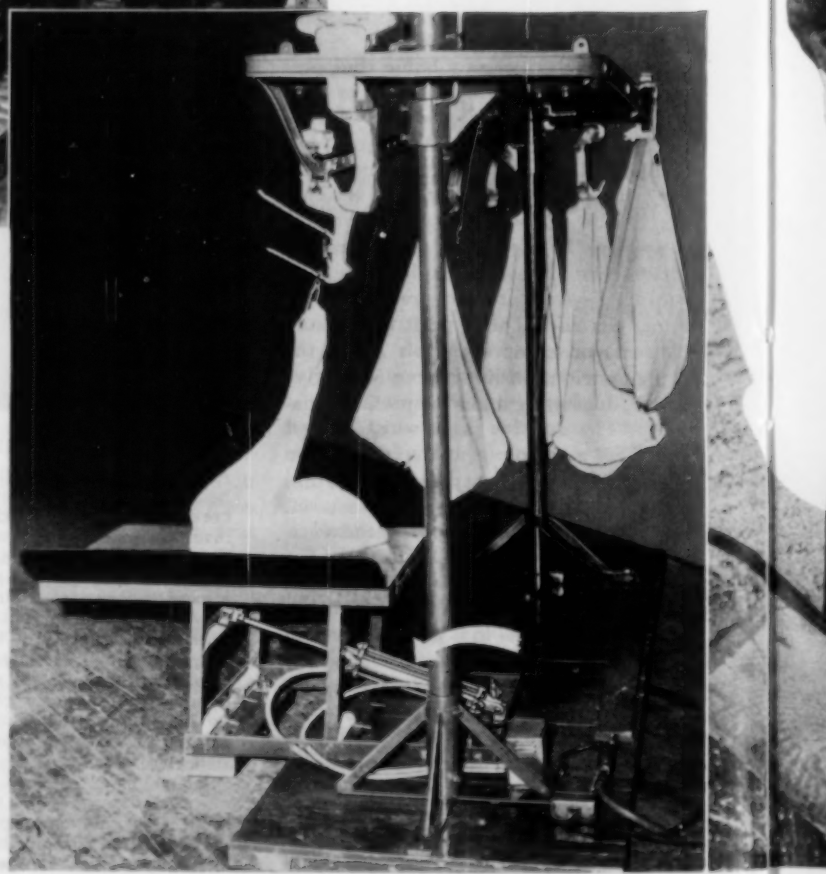
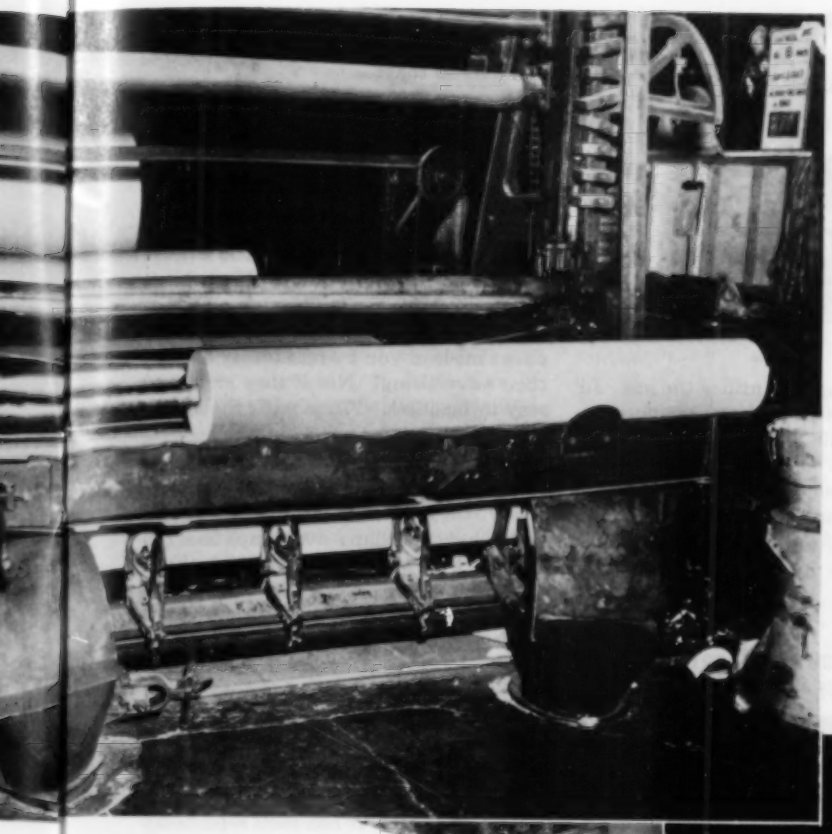


Net bags of damp, washed clothes are shown at the right arriving by monorail conveyor at a take-down station in a laundry. It is necessary to lift the nets to release them from the pin bar of the carrier bracket, and this was formerly an arduous task, especially as most laundry workers are women. The National Marking Machine Company, of Cincinnati, Ohio, which makes the monorail system, devised a lift which raises the nets, as pictured, so that they can be easily removed. All the nets on one bar belong to the same laundry bundle, and as all are taken down together the possibility of adding a net from another bar and thereby causing a mixup is largely prevented. The lift is operated by a Nopak air cylinder (indicated by arrow), manufactured by Galland-Henning Company, of Milwaukee, Wis. It is controlled by a foot valve and uses air at 60-90 psi. pressure.



The view at the left shows a roll of paper being moved horizontally by means of a cleated belt to remove it from the shaft on which it was wound. The latter consists of a longitudinally segmented steel jacket in which is a rubber sack that extends throughout its length. When the sack is inflated with compressed air, it expands the jacket to its full diameter for paper winding. Release of the air contracts the jacket so that the roll can be readily taken off, the operation requiring as little as three seconds. The pneumatic shaft was developed by L. L. Collard, a shop foreman in the Camas, Wash., mill of Crown Zellerbach Corporation. Twenty-five of the devices are in use at the Camas mill, and Mr. Collard has formed his own company to manufacture them for the papermaking industry.

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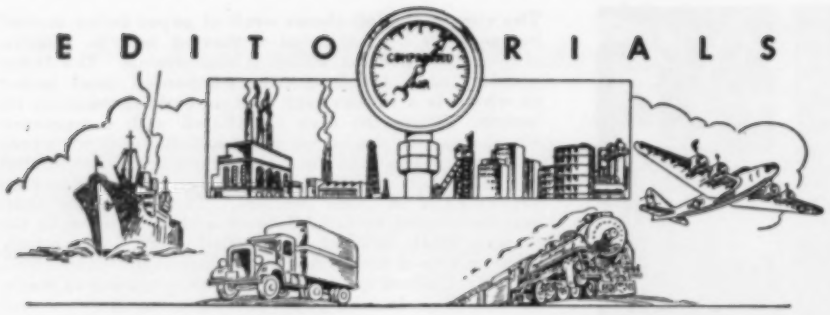
The Bunker Hill & Sullivan Mining & Concentrating Company had trouble in its Kellogg, Idaho, mines in emptying tramming cars carrying wet, sticky ore. In an effort to remove adhering material, cars were bumped with the haulage locomotive, and in one case this had to be done 120 times to shake all the ore loose. Now an air vibrator, made by the Cleveland Vibrator Company, is slipped into a bracket as shown below, the dumping latch is tripped, and the air turned on with a hand valve. Cars are being emptied clean in as little as ten seconds, and they, as well as the locomotives, take less of a beating than they did before. Plans are being made to use the vibrators at all main-haulage dumping stations.

Illustrated at the left is an air-operated saw that works on the same principle as a hand saw but cuts up to twenty times faster because its 21-inch-long double blade shuttles back and forth through a 4-inch stroke 1500 times a minute. It will cut to any depth, and is claimed to be equally effective for crosscutting, ripping, or notching. It weighs 14 pounds and uses 60 cfm. of air at 90 psi. pressure. Its adjustable handle can be changed to permit sawing comfortably at any angle, and blades can be replaced in a matter of seconds. The tool is made by Wright Power Saw & Tool Corporation, of Stratford, Conn., and is the invention of the concern's president, John W. Wright.



SULPHUR SEARCH

WE ARE accustomed to hearing of shortages of strategic war materials. The latest one to join the parade is commonplace sulphur. Although the average citizen rarely sees any of the stuff, it is vital to the production of everything he eats and wears and to a great many of the things he needs. Most sulphur is put to use in the form of sulphuric acid, of which the fertilizer industry is the largest consumer. The acid also has countless industrial applications, and is essential in the manufacture of paper and explosives. Some of the present pinch is attributable to the increasing output of smokeless powder for military purposes.

The United States normally produces 85 percent of its own and half of the world's supply of sulphur from underground domes in Texas and Louisiana. These sources are being augmented by minor quantities extracted from natural gas. All told, our sulphur producers shipped 5,400,000 tons last year, as compared with only 2,233,000 tons in 1939. Stockpiles are decreasing, and to conserve them the Government has cut allocations to domestic users by 15 to 20 percent and has slashed exports by 28 percent. The impact of these reductions has already been felt in many parts of the world, especially in Great Britain.

While virtually all our sulphur is in elemental form, most of that originating in other countries comes from iron pyrites or "fool's gold," which contains approximately equal parts of iron and sulphur. Pyrites can be burned to drive off sulphur-dioxide gas, and the latter can be converted into sulphuric acid. However, under prices that have prevailed until recently this wasn't economical, especially as the iron that remains isn't in readily salable form. Now, however, Noranda Mines in Canada has developed a process by which elemental sulphur can be obtained from pyrites and is about to spend $4,000,000 on the first of a series of plants for that purpose.

Though great quantities of sulphur have been escaping from the stacks of smelters that reduce sulphide ores, plants in the United States recovered enough of the gas in 1948 to make 641,000 tons of sulphuric acid. Consolidated Mining & Smelting and a few other operators in Canada also trap and utilize the gas. In the face of the current shortage, more are planning to follow suit, and it is estimated that the nickel smelters at Sudbury, Ont., alone could produce 800,000 tons of acid annually at the present rate of operations. Steps are already underway to capture and treat some of the Sudbury gas.

WE BUY A SHIRT

ALTHOUGH establishments that have things to sell believe so implicitly in advertising that they spend more than five billion dollars annually to tell prospective buyers about their wares, a minor but considerable segment of the general public isn't sure that advertising is a good thing. The doubters think that the cost of the paid publicity is an unnecessary appendage tacked onto the sales price and that it would drop if advertising ceased.

From an over-all standpoint, perhaps, advertising does cost something. For that matter, so do containers and wrapping paper, but does anybody want to return to the days when crackers and prunes were displayed in open barrels and the grocer reached in with his hands to fill the customer's order?

Let's suppose nobody advertised anything and you wanted to buy a shirt. The clerk would have to spend a lot of time telling you about this one and that one and expounding the merits of each. Maybe you would never have heard of Sanforizing. More time to explain what it is. And, after he got through, perhaps you would be a bit skeptical. "What is this new-fangled thing, and will it work?" you would ask. Then you would get down to price, and you would wonder if the one quoted was reasonable. This is just a sample of what you would go through every time you bought something.

Now, let's consider the merchant that sells the shirt and the concern that manufactures it. Picture how much time clerks would spend in making sales and how many additional clerks would be needed. How would the merchant know which make of shirt to stock to please most of his customers? And how would he find out just what firms make shirts. Manufacturers could write letters to all the stores and send salesmen to visit them of course. Would there be any economy in that?

How much simpler it is now! Your daily paper tells you who sells shirts, what kind, and at what price. You walk into a store, ask for the one you want, and in a jiffy you've bought a shirt that satisfies you and that you feel will give you good service. Why? Because it bears a well-known brand name. How did it become well known? Through advertising. Do the shirtmaker and the merchant mislead you by misstating facts in their advertising? Not if they expect to stay in business. Firms with thousands or millions of dollars invested survive only by building up a reputation for giving fair value and dealing fairly. If they falsify, they cut their own throats.

We have perhaps oversimplified the matter, but what we have said about shirts applies to just about everything you can name from a clothespin to a yacht. Advertising not only greases salesmanship, as it has been said, but it also protects the buyer by fully informing him. Without it, every purchase would be a gamble, and inferior products would stand the same chance of selling as good ones.

As to the cost: It has been repeatedly demonstrated that a manufacturer or a merchant can cut operating expenses and reduce his selling price as volume grows. Advertising, more than any other one thing, helps him to increase volume. Does it, then, cost the consumer additional money?

Coming back to our opening statement, a lot of money is spent on advertising. The biggest spenders are the concerns that do the largest business in their lines. Their executives are hard-headed businessmen, not easily beguiled and not prone to throw away dollars needlessly. If they thought for a minute that they could do the same volume of business without advertising as they do with it, they would be the first to eliminate it.

Realizing that the people who question the value and validity of advertising probably don't understand too well what it accomplishes in our modern economy, the Advertising Federation of America is attempting in every possible way to inform the public. In one of its efforts it is starting at grass roots, so to speak. For five years it has been sponsoring essay contests in high schools, the purpose being to interest young people in the subject so they will acquire a knowledge of the facts that will permit them to evaluate advertising on its true merits. The most recent contests drew 50,000 entries, and through the writers of these papers thousands of teachers and parents also learned how advertising fits into our modern economy. America has always favored free speech, whether it be in behalf of a principle, an ideal, or a product. Advertising is industry's free speech.

Low's Rock Drill of 1863

Considered the Best of the Early British Creations It Embodied Numerous Surprising Features

IT IS generally conceded that the earliest practical rock drills originated in America, but this did not come about because European inventors were lax in their efforts to develop such machines. Within a span of 28 years beginning with 1849, when J. J. Couch of Philadelphia, Pa., introduced the first successful mechanically actuated drill, more than 80 designs were patented in England, France, and Germany, and innumerable others must have been abandoned before they reached that stage.

British writers on the subject consider a drill invented by George Low, of Ipswich, to have been the best of the many models developed in England. It was patented in 1863 and improved upon in 1865. Low commissioned the firm of E.R. and F. Turner of Ipswich to manufacture the drill for him, and it enjoyed considerable popularity for a few years until more effective machines based upon American designs began to appear in Europe. The most notable job with which Low's drills were identified was the driving of the Roundwood Tunnel in Ireland in 1867. The 6x5-foot bore through trap rock was started with hand drills, and the weekly advance, working three shifts a day with three men per shift, was 2½ feet. The rate of progress was trebled when Low's drill took over.

We are indebted to Gerald Von Stroh, Director of the Mining Development Committee of Bituminous Coal Research, Inc., Huntington, W.Va., for the accompanying illustration, which originally appeared in a book, *Underground Life; or Mines and Miners*, written by Louis Simonin and published in 1868. From the same source we quote the following description of the drill:

"In consequence of the difficulties connected with the prosecution of underground operations when carried on by manual labour in a hot and vitiated atmosphere, the attention of inventors has of late years been directed to the subject; and various attempts have been made to contrive a machine by which rocks may be bored or worked away, and coal hewed.

"The principle on which these machines have been devised is either that of boring a hole by the continuous motion of a rotating drill, or by means of intermittent blows delivered with a pointed tool, striking the rock after the manner of blows delivered from the elbow and shoulder of a man. In the rock-boring machine invented by Mr. George Low, and manufactured by the Messrs. Turner, of Ipswich, the work is effected by a combination of both these operations.

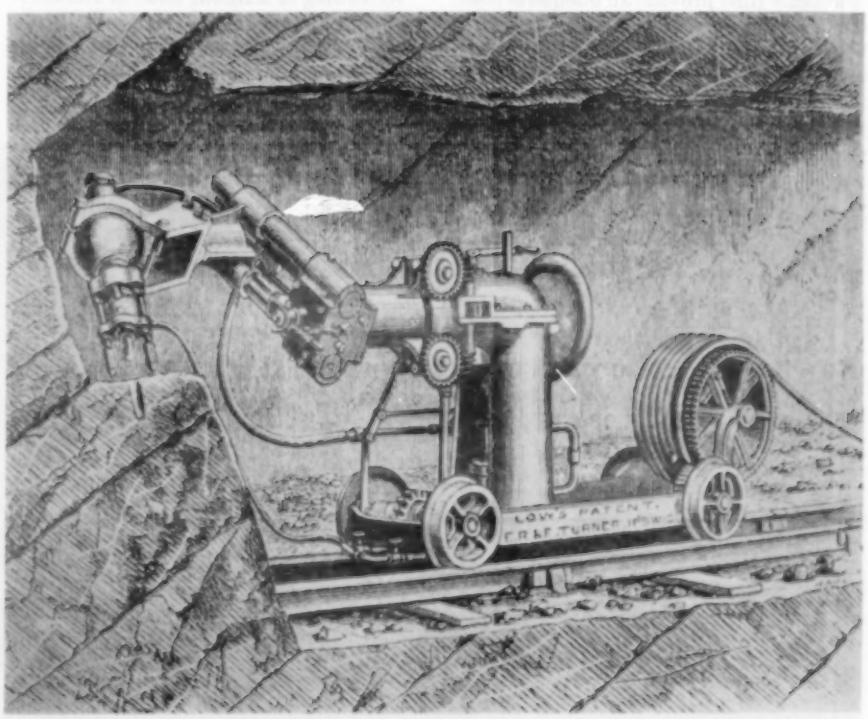
"The machine consists of a boring cylinder, into which the tool (very similar to the ordinary hand-tools) is inserted. This cylinder moves within another cylinder, in which it is made to rotate slightly but continually between each blow of the drill, which strikes the rock upon one spot at the rate of from 300 to 500 blows per minute. Holes of two inches in diameter can be made in the hardest granite at the rate of two inches per minute, while in softer stone double that rate has been attained. That portion of the machine which bears the drill, and to which, of course, all the rest is accessory, is borne upon an iron frame, running upon wheels, on rails about two feet apart, and is moved backwards and forwards by a small engine, which is encased within the iron column supporting the drill.

"The reciprocating motion of the boring-tool is produced by compressed air or steam. The former is preferred in underground work, as it serves to ventilate the workings, whilst the steam produces an atmosphere unsuited for respiration. When the air is used, it is compressed into a large receiver, similar to a steam-boiler, by Low's hydro-air-compressing engine, which consists of two powerful air-pumps worked by a steam-engine. In Low's process the compressed air is forced through water, which deprives it of all its heat, and enables a higher pressure to be attained than is practicable by any other process. For working the boring-machine a pressure of from seventy lbs. to ninety lbs. per square inch is necessary. This may be conveyed through India-rubber tubing to any distance with little loss of pressure, so that the engine and air compressor may be at the mouth of the workings, whilst the boring-machine may be at work underground at a distance of a mile or more. The air is conveyed to the boring-cylinder through tubing which is coiled upon a drum at the back of the machine, which uncoils itself as the machine is advanced, and recoils itself when the machine is drawn back from its work. When the air is not used by the boring cylinder it is applicable for propelling the machine to and fro by the small engine encased in the column, which by a suitable arrangement of gearing is made to propel the machine, or to raise and lower the boring-cylinder, and to turn it to any angle it may be required to work in.

"Owing to an ingenious arrangement there is an air space at the top of the boring cylinder, which is always filled with compressed air. This forms an air-cushion which receives the concussion of the blows, and prevents the crystallization of the working parts, and enables the machine to stand as steady when delivering 400 blows per minute as when it is not at work.

"The fragments of stone are removed from the bore-hole by a powerful jet of water obtained from the waste through which the air is compressed, so that the tool has never to be withdrawn except for sharpening, even with a perpendicular hole."

Several features of the drill are worthy of emphasis. The drill rod was rotated by means of a spiral bar and ratchet mechanism, a scheme originated by Low and still followed in principle. It is surprising, too, to find that compressed air was employed as a cushion on the backward stroke of the piston, thereby prolonging the service life of the parts that



LOW'S CREATION

Early descriptions correctly called this a drilling machine rather than just a drill. While its weight was not stated, it was obviously great enough to call for a carriage mounting. The machine is shaped more like a turret lathe than a modern rock drill, a considerable portion of its complicated mechanism having been designed to position the drilling element rather than to operate it. The air-driven reciprocating motor that effected these movements through gears and also propelled the ponderous assembly along the rails was built into the supporting column.

were subjected to repeated impact.

The use of a hose reel and of an air-driven engine for moving the carriage over the rails also establish the fact that these features were conceived much earlier than is commonly supposed. It is likewise apparent that the India-rubber hose then available could withstand relatively high pressures, and it is inferred that air was conveyed through it for long distances. Another interesting angle is the reference to compressed air being the preferred form of power for operating the drill.

Because the compressor is given only passing mention, it may be assumed that there was nothing particularly new about it—that it was a machine in somewhat common use at the time. This somewhat parallels the first descriptions in this country of George Westinghouse's air brake, which was introduced in 1869. Thousands of words were devoted to the brake itself in these accounts, but virtually nothing was said about the compressor that supplied the air, the inference being that machines of this type were already available and so well known as to require no comment. Nevertheless, technical literature tells us very little about just when compressors were originated, or by whom. If any of our readers can shed any light on this apparent gap in the history of an important industrial machine we would appreciate hearing from them.

Saving Tin by Use of New Precision Gauge

LESS than six ten-millionths of an inch (0.0000006) is an extremely fine margin of error in any measurement, but not too fine, says the United States Steel Corporation, when dealing with tin. This metal is of importance to us because it protects the contents of billions of cans of food bought annually by American housewives. As we are dependent for most of our supply on foreign sources, it behooves us to practice conservation, and this is being done by U.S. Steel through the medium of a new thickness gauge devised in its research laboratories.

The cans are made from especially selected and rolled sheet steel, which is plated by dipping it in molten tin or by continuous electrolytic action. In either case, the thickness of the film should be carefully controlled to save metal and at the same time provide an adequate coat. In order to insure such close control in the case of the hot-dip method, the scientists have combined the industrial X-ray and the Geiger counter in a gauge that makes it possible to measure coatings with a precision of approximately 1 percent.

Gauging is done by simultaneously exposing a sheet of tin plate to an X-ray beam and measuring the secondary rays reflected by the steel beneath the tin with the Geiger counter. Some of the secondary radiation is trapped by the tin, and that which reaches the counter is in inverse proportion to the thickness of the coating. In practice, tin mills measure both sides of a sheet at the same time by placing it on a table between two X-ray gauges, one above and the other below. Only 30 seconds after pushing a button to start operations the gauges shut off automatically and the measurements made meanwhile by the Geiger counters are printed for easy reading on moving paper tapes.

Hardwoods a Source of Wood Pulp

OUR plentiful stands of hardwoods are being drawn upon for the production of wood pulp for which we have in the past depended upon softwoods, mainly spruce. With paper consumption steadily on the increase and softwoods dwindling, this information is significant.

According to a recent issue of *Industrial Bulletin* published by Arthur D. Little, Inc., "Two high-yield processes are in use for making hardwood pulp." One was developed about 25 years ago by the U. S. Forest Products Laboratory, but had to await certain mechanical advances before practical application. It is what is known as the "semichemical" process by which the logs are reduced to chips that are digested with a relatively weak cooking liquor and, when softened, readily break down under mechanical treatment in water. The partially cooked pulp contains much of the lignin and other noncellulose parts of the wood and can be handled by conventional paper-mill equipment. The method has been adopted by several mills engaged in the manufacture principally of heavy boxboard and corrugated paper where weight and stiffness are desirable and the color imparted by the lignin is not objectionable. However, recent investigations have revealed that semichemical pulp can be bleached for making book, bond, tissue, and glassine papers.

The other hardwood process is a new one and was developed at the New York School of Forestry under a program sponsored by a group of paper manufacturers. The end product is called Chemigroundwood, which is made by grinding up whole logs after softening them for six hours in a hot, neutral sulphite liquor. To insure deep penetration of the chemical, a vacuum is pulled on the wood before the liquor is introduced under a pressure of 200 psi. The pulp is being turned out on a commercial scale for the production of newsprint. Further, because it can be bleached to a whiteness that compares favorably with that of ordinary groundwood, it can be used to manufacture tissues, paper napkins, as well as some kinds of book paper and paperboard.

PORTABLE WARNING SIGNAL PYLON

The portable pylon pictured here with a flashing light on top is intended to warn motorists and pedestrians that a street is blocked for emergency utility-line repairs and was developed by Goodyear Tire & Rubber Company at the request of Consolidated Edison Company, of New York City. Made of a rubberized fabric, it can be quickly inflated, as shown, and collapsed into a small package when no longer needed. The upper section is filled with air and the base with water to hold the pylon in place. It is made in two sizes: 6 and 12 feet high when set up.

World's Deepest Lead Mine

H. W. Ingalls

SOME idea of the potentialities of a mining property in the Coeur d'Alene District of Idaho can be gained through a study of the history of the Morning silver-lead-zinc mine at Mullan, which, at a depth of 5050 feet, is believed to be the deepest lead mine in the world.

The Morning is now owned by the Federal Mining & Smelting Company, in which the American Smelting & Refining Company owns the controlling interest. In the 44 years from 1905 to 1949, inclusive, it produced approximately 10,000,000 tons of ore and compiled net earnings of $26,735,677.54 before deducting depreciation, depletion, its proportion of general administration expenses, and corporate, state, and Federal income taxes.

The Morning and Evening claims were located July 2 and 3, 1884, by two prospectors, George S. Good and C. C. Earle, whose discovery work disclosed a large iron-capped vein. No ore of any consequence was found in the first prospect tunnel. Other than that there is no record of the early days of the property up to the time a group of miners attempted a coöperative operation through the No. 2 Tunnel, which ended in failure. Then Warren Hussey, a local banker, tried to work the mine and was also unsuccessful.

Later the property was sold to Charles M. Kipp and John S. George, of Milwaukee, Wis. They built a concentrating mill at Mullan and connected it with the mine by a steep narrow-gauge railroad equipped with a Shay locomotive and a train of 20-ton ore cars. They carried on for a number of years until the mine passed into the hands of two railroad contractors—Peter Larson, of Portland, Oreg., and Thomas L. Greenough, of Missoula, Mont.—under a lease and bond agreement.

Operating in the Nos. 2 and 3 tunnels at an elevation of approximately 3800 feet, or about 1800 feet below the surface, Larson and Greenough made enough profit on the lease to take up the bond price. They continued working the ore body on down through No. 4 Tunnel, then jumped to No. 5 Tunnel 400 feet lower, and next drove No. 6 from the mill level 2 miles to the vein, 800 feet below No. 5. Meanwhile, they had added to the west end of the Morning ground the Grouse and Iron Crown claims and had purchased the What and You Like claims located on a parallel fissure vein 1000 feet south of the Morning, besides adding sundry other properties covering the No. 6 tunnel site, calling all the Morning group. The You Like proved to be a rich vein, but its ores were always mixed with the Morning tonnage.

No record of Larson & Greenough's production was available until 1902, which was about the time Idaho passed a law requiring mining companies to file statements of their net profits with the county recorder as a basis for taxation. Their statements for 1902, '03 and '04 showed total gains of $793,153.95. Around October, 1905, when the No. 6 Tunnel was completed and in operation, Larson & Greenough sold the mine for $3,000,000 cash to the Federal Mining & Smelting Company, a corporation organized by Charles Sweeney, of Spokane, Wash., and financed in New York. The latter started sinking from the No. 6 tunnel level, which is really the No. 8 mine level, and has continued work down to the present depth of 5050 feet, which is 940 feet below sea level.

The Morning ore body has a strong "rake" to the west, and at the lowest level it apparently passes into the Star Mine owned by the Sullivan Mining Company, a subsidiary of the Bunker Hill and Hecla Mining companies, and rated as the largest zinc-lead deposit in the Northwest. In the wedge of ground terminating at the Star property line, the Federal company, in its 1947 annual report, estimated that there remained unmined 32,500 tons of lead, 39,200 tons of zinc, and 942,000 ounces of silver.

The distance between the Morning mine opening at Mullan and that of the Star at Burke is approximately 15 miles by highway; but on the lower levels, where the properties are connected, electric-powered ore trains quickly cover the stretch of around 4 miles that separates the two towns underground.

MORNING MINE AND MILL

Mining was started high up on the mountain in the 1880's and successive tunnels were driven, at progressively lower elevations, during ensuing years. No. 6 Tunnel enters at the valley level, shown here. Workings extend downward from it to a depth of 5050 feet below the mountain top and 940 feet below sea level. Early records are not available, but since 1905 the mine has produced more than ten million tons of ore and earned in excess of $26,000,000.

This and That

Air Aids Happy Landings

Explosives, delicate instruments, and the like can be dropped from an airplane by parachute without hazard or damage, it is claimed, by encasing them in a package designed by Harold Cohen, instructor in product design at the Illinois Institute of Technology. The container offers so much protection from shock that even an egg can be landed without breaking it, it is said. The object is held between two elastic diaphragms that are backed up by cushions of compressed air. The pressure in the casing is controlled by valves and may be varied according to the size, weight, and density of the material or object concerned.

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Salvage Expert Retires

A man who has served a firm for 53 years is, unquestionably, entitled to slacken up a bit. With that in mind, Thomas A. Scott informed stockholders of Merritt-Chapman & Scott Corporation early in April that he was going to ask the board of directors to relieve him of his duties as board chairman and corporation secretary. He will, however, continue as a member of the board and will probably work about as hard as ever.

Mr. Scott was, one might say, born into the construction industry, his father having founded a marine-salvage and transportation firm. The son joined it immediately after his graduation from Mystic Valley Institute in 1896, and served successively as a blacksmith's helper, seaman, ship's captain, salvage officer, and operations manager. He became president when the concern was incorporated in 1903 as the T. A. Scott Company, and continued in that post when a merger in 1922 created the Merritt-Chapman & Scott Corporation. As a Navy commander during World War I, he directed all salvage of naval and commercial shipping in American waters and some in European waters. For those efforts, as well as those of his firm during the past two world conflicts, he was awarded the Medal of Merit in 1946 by President Truman.

"See, boss, the bit is magnetized. The iron in the ore attracts it, the drill rod bends, and we get a hole straight to the ore body."

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Palm-Oil Problem Solved

At one stage in the manufacture of tin plate it is dipped in palm oil to give it properties which, until recently, could not be imparted to it by any other substance. In fact, years of unsuccessful searching had led to the conclusion that there was no adequate substitute for palm oil. This belief has now been dissipated, according to the Armour Research Foundation of the Illinois Institute of Technology. After several years of effort, two of its staff members, William R. Johnson and George C. Ference, have determined that specially processed tallow is a suitable alternate material. This announcement was made after the product had turned out satisfactory tin plate under regular operating conditions in a major steel plant for more than a month.

Our steel mills have been using around 7000 tons of palm oil a year, practically all of it imported from the East Indies and North Africa. The adoption of tallow will relieve the uncertainty during periods of international conflict of obtaining the necessary supplies, give American packers an additional outlet for their overabundance of tallow, and save the steel industry up to $1,000,000 annually at current market prices. The research that led to the discovery was undertaken at the request of the American Iron & Steel Institute.

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Airdent Now on Market

The first Airdent units for drilling teeth with an abrasive blast were shipped to dental colleges in December by S.S. White Dental Manufacturing Company, of Philadelphia, Pa., and now some are being delivered to practicing dentists. If the apparatus lives up to its promises, it may, in years to come, do much of the tooth work performed by conventional drills. Its general adoption, however, will have to await the day when dentists can use it properly and will no doubt be further delayed by their traditional reluctance to change time-tested techniques.

"He's working a double shift."

As previously reported in these pages, the Airdent is a miniature sandblasting machine that propels a tiny stream of aluminum-oxide powder through a nozzle under a pressure of 60 to 70 psi. For convenience, carbon-dioxide gas drawn from commercial cylinders is used instead of compressed air. The principal virtue of the apparatus from the patient's standpoint is that it promises to eliminate the pain and nervousness caused by the pressure, vibration, and heat associated with the equipment now in service. But because it drills only round holes, the Airdent cannot be used where angular recesses are required. The device has been under development since it was invented in 1942 by Dr. Robert B. Black, a Corpus Christi, Tex., dentist.

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Gasoline and Oil From Coal

The first modern, commercial gasoline-from-coal synthesis plant is soon to be erected in South Africa. It represents the initial step in a program to make that nation, which has insignificant petroleum production but large reserves of coal, independent of outside sources of gasoline supply. The plant, which will be the largest industrial project undertaken in South Africa since the last war, will be operated by the South African Coal, Oil & Gas Corporation Ltd. The government has allocated eighteen million pounds ($30,240,000) towards its construction. It is expected that the initial annual output will approximate 60 million gallons of gasoline and diesel-engine fuel, with alcohols and

oxygenated chemicals as by-products.

The "Synthol" process is to be utilized. It is an improvement upon the technique employed by the Germans during the last war and was developed by M. W. Kellogg Company, of Jersey City and New York, which will also design the plant and direct its construction. The site is on the Vaal River near the town of Coalbrook in Orange Free State and about 40 miles south of Johannesburg. Shafts will be sunk and machinery installed to open up virgin coal deposits; and complete surface facilities, including an oxygen-producing plant, will be provided to gasify the coal and to convert the gas to liquid hydrocarbons. Some indication of the size of the plant is gained from the fact that just one of the several generators that are to be used in transforming coal into gas could supply the domestic needs of an American city with a population of 150,000.

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Good to the Last Particle

Experiments made by Arthur D. Little, Inc., in connection with the development of atomic energy showed that a cubic inch of air may contain up to 20,000 particles of dust and other contaminants. Conventional cleaning devices reduced the number to between 1000 and 3000. To obtain better results, the firm produced a filter using special soft felt-like paper and submicroscopic asbestos fibers that removed, on an average, all but one particle. A new firm, Cambridge Corporation, has been organized to manufacture the superfilter for service wherever especially clean or sterile air is required, as in hospitals, biological laboratories, and establishments making pharmaceuticals and precision equipment.

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Shafts Float on Air

One of the knottiest problems in connection with the development of guided missiles is that of contriving the steering mechanism. The latter must detect and correct the tendency of the missile to deviate from its charted course, for otherwise it would not reach its destination. Scientists of North American Aviation, Inc., have reached new highs in precision in coping with this problem in the concern's aerophysics laboratory at Downey, Calif. The heart of the controller is a gyromechanism that must be constructed with great accuracy. For these machines, the research staff has built rotors that weigh several pounds and that are only three milligrams out of perfect balance when rotating at 36,000 rpm. Three milligrams is about one-third of the weight of a pinhead.

The rotor shafts are measured to a tolerance of ten-millionths of an inch and turn on air bearings, the air serving both to suspend and lubricate the shaft. It is forced in through drilled capillaries that are only three-thousandths of an inch in diameter, too small to be seen by the unaided eye. Supported on a film of air one-thousandth of an inch thick, the shaft is so nearly frictionless that the weight of a feather will turn it. North American is believed to be the first firm to have put these bearings to practical use in various instruments. Detailed information regarding them has not been released.

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Havens from A-bombs

The modern sword of Damocles—the atomic bomb—is wielding a potent influence on modern construction. In populous areas and centers of industrial activity, the planning of new buildings now includes careful attention to the provision of adequate shelters for use in case of air attacks. The result will be to increase excavation, and in rocky areas this will call for additional drilling and blasting.

Most publicized of the facilities of this type now under construction is the cellar of the White House in Washington. It has recently been disclosed that a shelter was built there in 1942 as a precautionary measure; but President Roosevelt visited it only once and refused to go there during practice air-raid drills because he considered it depressing. The quarters were designed for temporary occupation, but more elaborate ones are being included in the renovation of the building now in progress. They will include a combination living room and office, a bed chamber, cooking facilities, and a complete ventilating and air-purifying system that will afford protection against poison gas and radioactive dust particles. An intricate radio, telephone, and telegraph network would enable the president to remain in communication with government and military leaders even during a raid. The steel-and-concrete walls of the shelter are 9 feet thick, and a tunnel connects it with the Treasury Department.

In New York City last fall the board of managers of St. Luke's Hospital awarded a contract for a new $3,000,000 structure that will include caverns in the bedrock of Manhattan for use of patients, doctors, and nurses in the event of a bomb attack. It will, it is believed, be the first hospital in the metropolitan area to provide such facilities.

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Tough Job in Store

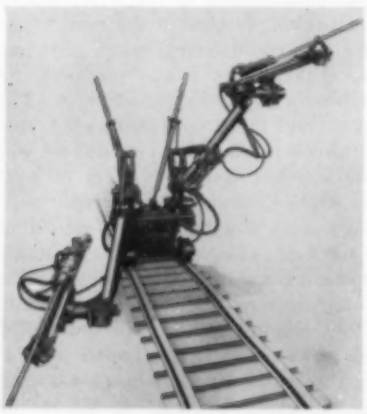
A 59-mile transmission line to be strung across the Continental Divide in Colorado presents one of the toughest jobs of its kind ever tackled. To extend from a point near Salida east of the range to Gunnison on the western slope, it will traverse some of the most rugged terrain in the country, much of it more than 10,000 feet above sea level and reaching an extreme elevation of 11,312 feet. The 115-kv. aluminum-clad, steel-reinforced cable will be carried on some 1000 wooden standards from 50 to 75 feet high. Special bracing will be required on a 4-mile stretch lying above 10,400 feet to withstand the expected ice accumulations up to 1¼ inches thick and 60-mile-an-hour winds at temperatures as low as minus 20°F. The line will deliver power from hydroelectric plants of the Bureau of Reclamation's Colorado-Big Thompson Project. It will be built within a time limit of 420 days by the Trans-Electric Company of Louisville, Ky., under an $821,499 contract—roughly $14,000 per mile.

"Frank's decided to eat up here, I see."

Industrial Notes

Something new in roadbuilding machinery has been designed by the Bridgeport Implement Works. It's a trailer-type "rake" that removes stones from shoulders, from secondary roads under construction, and in advance of seeding operations in development work. Called the Pixtone, it is said to pick up stones ranging in size from 1½ to 10 inches and to have a carrying capacity of 1¼ tons. The load is dumped by tripping a lever.

More production with less effort, says Ingersoll-Rand Company, is obtainable with its new Boom Jumbo than with conventional column-and-arm methods. This mobile drilling rig is designed to drive drifts, crosscuts, and tunnels with a maximum height of 10 feet and a width of 12 feet. It carries two drifters, each of which is mounted on a boom that relieves the operator of heavy lifting because it is raised and lowered into working position



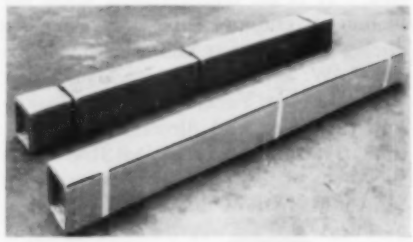
SAVES HEAVY LIFTING

The car on which the booms are mounted can be easily dismantled and reassembled for transportation through shafts. All air and water piping is enclosed and protected by the car body. At the front of the latter is a box for tools and at the rear a 6-quart lubricator with a metering valve for each drifter.

in a matter of seconds by a powerful air motor. The latter is controlled by two valves, one on each side of the boom for the convenience of the drill runner, and the power-feed and drill controls also are within easy reach. To make doubly sure that the boom will not creep, settle, or drop when air is turned off, it is provided with a self-locking worm gear and screw drive for raising and lowering. When locked, it is held rigidly in place by a double-tapered clamp, and loosening a nut permits swinging it in either direction. Two ceiling jacks which, combined, exert a pressure of 32 tons hold the jumbo in drilling position regardless of overbreaks or high ceilings, while a counterweight at the rear end of the car maintains balance. The booms are fabricated of seamless-steel tubing with heavy vertical supports and can be purchased separately for mounting on jumbos of different types and sizes for service in tunnels of larger cross section. Because they can be used with long feeds they make it possible to take full advantage of Carset Jackbits that retain their cutting edges much longer than ordinary detachable bits

Castings with a core of one metal and a shell of another are being produced to specifications by the United States Pipe & Foundry Company. Each metal is melted in a separate furnace and poured successively into a spinning mold—first that for the shell and then that for the core, the latter without interrupting rotation. The process, known under the trade name Dual Metal, is used to make rolls of gray iron surfaced with chilled iron or stainless steel for textile, papermaking, and flour-milling machinery; diesel-engine cylinder liners of steel on alloy or gray iron, etc. Products range from 4 to 30 inches in outside diameter, up to 10 feet long, and in any desired wall thickness from a minimum of ½ inch.

As a substitute for metal and other strapping for shipping containers, the Mid-States Gummed Paper Company is offering a tape that is said to be the strongest of its kind. It is made of tough, resilient fibers running lengthwise in a special bond and laminated between two sheets of Kraft paper one of which is coated with glue. According to the manufacturer, its Tape-Strap has a tensile strength averaging 180 pounds per inch of width and has been used to reinforce cartons containing up to 800 pounds of material. Pliable and easily applied, it does not cut into and damage cartons. Most standard-type dispensers will take the tape, but some may have to be fitted with the special cloth-shear attachment obtainable from the company. The accompanying picture shows shipments of metal molding weighing between 400 and



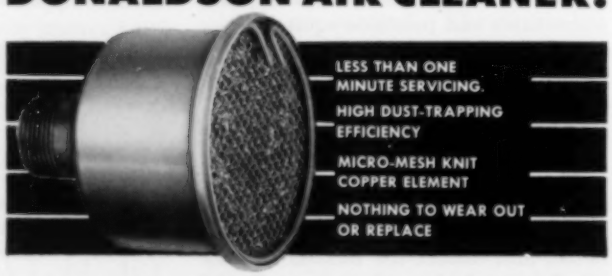
600 pounds. The metal-bound case in the back has been replaced by the double-walled, corrugated carton secured with Tape-Strap.

Two new machines to facilitate the manufacture of sheet-metal parts are being built by the Hufford Machine Works, Inc. One is a shrink finishing machine and the other a planisher. Both are air-operated and are of especial interest at this time to the aircraft industry because they permit the use of women workers on jobs that are usually restricted to male labor. The shrink finisher removes the wrinkles that commonly appear on parts formed on rubber-pad presses when edges are turned and the sheet metal is placed in compression. This work, formerly a fatiguing manual job, is done by a mechanically driven lead "slapper" which is mounted on top of the machine's

NEW! Low Cost

Micro-Mesh

DONALDSON AIR CLEANER!


LESS THAN ONE MINUTE SERVICING.
HIGH DUST-TRAPPING EFFICIENCY
MICRO-MESH KNIT COPPER ELEMENT
NOTHING TO WEAR OUT OR REPLACE

No Tools Required for Servicing

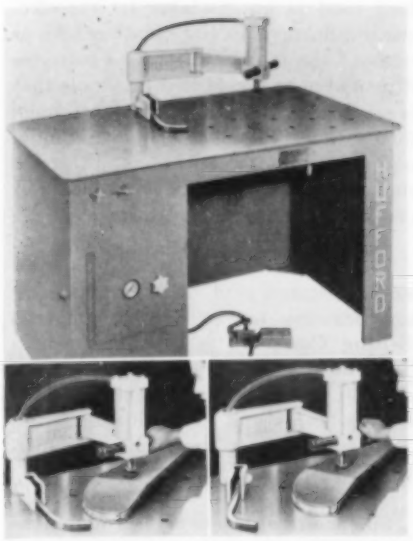
To service, squeeze snap ring together with fingers, removing ring and outer screen. Lift out element . . . wash in kerosene or other solvent. Re-oil and re-insert in cleaner body and replace screen and snap ring. Body of air cleaner need not be removed.

Efficient . . . compact . . . simple to attach and service . . . the new Donaldson Micro-Mesh air cleaner meets every qualification for installations where air requirements are moderate, yet its cost is less than that of oil-washed types. It filters efficiently at any angle, simplifying design problems. Dust entering cleaner is trapped on an oil-wetted filter element, knit from a continuous strand of crimped copper ribbon. Uniform in density, the filter element is placed in the deep-drawn, terne-plate body under slight compression. It will not break down, shift or sag.

Sample Cleaner Sent On Request

DONALDSON COMPANY INC.

666 PELHAM BLVD. • ST. PAUL 4, MINNESOTA



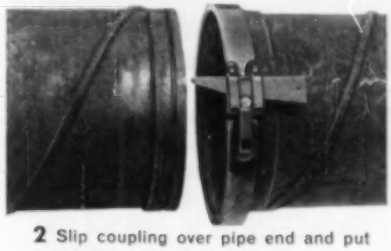
SHRINK-FINISHING MACHINE
In the left-hand picture, bottom, the form block is shown with a wrinkled workpiece in position preparatory to admitting air to the pneumatic clamp and starting the "slapper" (curved bar at left). As the block rotates, the slapper strikes the sheet-metal part to make it smooth, as seen at the right.

steel table together with the workpiece attached to a rotating form block. During the finishing operation the latter is held securely by a pneumatic clamp actuated by a foot valve. When the pedal is further depressed, the slapper begins to strike a series of blows along the edge of the sheet-metal part and continues to do so until it has covered the entire periphery. The frequency of the blows is varied to meet requirements. The form block, with the work still in position, is then put on the planishing machine, where any remaining minor defects are smoothed out by an air-driven hammer assembly.

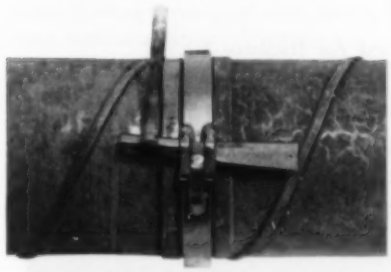
Airlarm of Houston, Tex., is offering a heavy-duty unit for compressed-air systems that sounds a warning when the pressure drops below the point where it is not safe to operate equipment. Functionally, it is the same as an earlier model but has been modified structurally to permit a price reduction through manufacturing economies. The new device consists of a valve element and of a shrill whistle. When the line pressure falls below the preset point, the valve automatically opens and allows air to escape. This starts the whistle, which continues to blow until the pressure is restored. Then the alarm stops.

There is danger of shock and even of electrocution in the aluminum or magnesium poles commonly used in trimming trees along power lines. To eliminate the danger incident to accidental contact, J. B. Sebrell Corporation is making 4-foot lengths from a plastic

1 Drive wedge into the two parallel lugs to open coupling.



2 Slip coupling over pipe end and put next joint of pipe in place.



3 Drive out opening wedge so coupling snaps into place on grooved ends of pipe.

4 Drive wedge home into the three lugs on coupling.

You can connect

NAYLOR PIPE

with a hammer...

when you use

NAYLOR WEDGE-LOCK COUPLINGS

One, two, three, four—and the connection is made in seconds, not minutes. And a hammer is the only tool you need.

That's how simple it is to connect Naylor Pipe with Naylor Wedge-Lock Couplings. Built in one piece with gasket already in place, this Naylor Coupling provides a tight, leakfree joint faster than ever before possible.

Since the coupling takes up little more room than the pipe itself, it permits the line to hug the wall in tunnels or wherever space is limited. Lines can be made up with only one side of the pipe in the open.

For the full story on this practical Naylor combination, write for Bulletin No. 507.

NAYLOR PIPE

Naylor Pipe Company, 1245 E. 92nd St., Chicago 19, Ill.
New York Office, 350 Madison Avenue, New York 17, N.Y.

HOW YOU SAVE,
Getting Drier Compressed Air

● Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

Write for complete information; ask for Bulletin No. 98

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. CA 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

long used as an insulator by the electrical industry. In combination with or without the metal sections, as many as fifteen may be joined to form a pole that is safe and light enough to handle though 60 feet long. The plastic, like aluminum and magnesium, weighs about a third as much as wood, and will not splinter or crack under normal conditions.

For conveying or elevating foundry sand, castings, and other products at temperatures up to 600°F., Imperial Belting Company is manufacturing a heat-resistant belt in a wide range of sizes. It is made of heavy duck combined with asbestos and insulating materials and is sold under the name of Super-Insulated Sahara Belting.

Silicone-treated lens tissues double the size of the usual sheets and a wall-mounted dispenser that supplies one at a time are offered by American Optical Company to help workers keep safety goggles clean. The tissues measure 5x6 ¾ inches and come in packets of 800, six to a carton. The dispenser has a lock to prevent pilfering.

Air and hydraulic cylinders that come fully equipped with piping for ease of installation have been announced by the Miller Motor Company. As the accompanying illustration shows, the piping is directly connected to ports in a flat-surfaced mounting plate or manifold, and the cylinder ports are in line with the ports in the plate. At the mating points are "O" ring seals which are preassembled in the cylinder ports and insure leak-proof joints under pressure and suction. The cylinder flanges are secured to the

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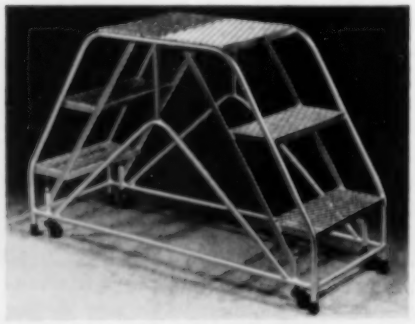


SAFETY LADDER

There is plenty of room on this ladder for two people to work side by side on large assembly jobs, in stock-room aisles, and in performing numerous other services. With steps at both ends, each can go about his business without interfering with his coworker. When not in use it moves easily on swivel casters; but when someone stands on it, the weight causes spring-mounted rollers to be deflected and rubber-tipped legs to engage the floor, keeping the platform stationary. Built of aluminum-finished steel by the Ballymore Company, the ladder is 30 inches high, 17½ inches wide, and 48 inches deep.

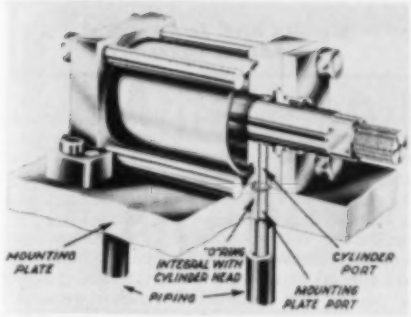


plate by regular bolts or screws, thus obviating the need of making or breaking pipe connections when dismounting a cylinder for removal or replacement. Other advantages claimed by the manufacturer for the new "O" Ring Cylinder Mountings are: smoother fluid flow, minimum pressure loss, and elimination of turbulence and aeration because there are no sudden changes in transverse internal sections of pipes and fittings.

U. S. Army engineers have developed a collapsible storage "tank" for gasoline with a capacity of 10,000 gallons. It is made of rubber and nylon and is transported from one theater of operations to another in a protective box. When needed, it is unrolled on the ground like a rug and looks like a huge cushion when filled.

A lubricator in the shape of a fountain pen with a clip so it can be conveniently carried in the pocket is being marketed by Gaunt Industries. Slight pressure on the plastic oil chamber ejects the lubricant from a hypodermic needle made extra long to reach inaccessible places. The handy gadget is intended primarily for mechanics and millwrights and is called Hypo-Oiler.

CHIC AND LIGHTWEIGHT

Now that women are flocking back to factories, hat designers have been busy trying to contrive an inexpensive model that will meet industrial needs and be becoming at the same time. The Boyer-Campbell Company thinks it has just the thing in its Ray-ve. Made of washable blue taffeta, it keeps the scalp cool, and its adjustable snood takes care of any amount of hair, which is always completely confined as it should be for safety.

STAYS RIGHT ON THE JOB!

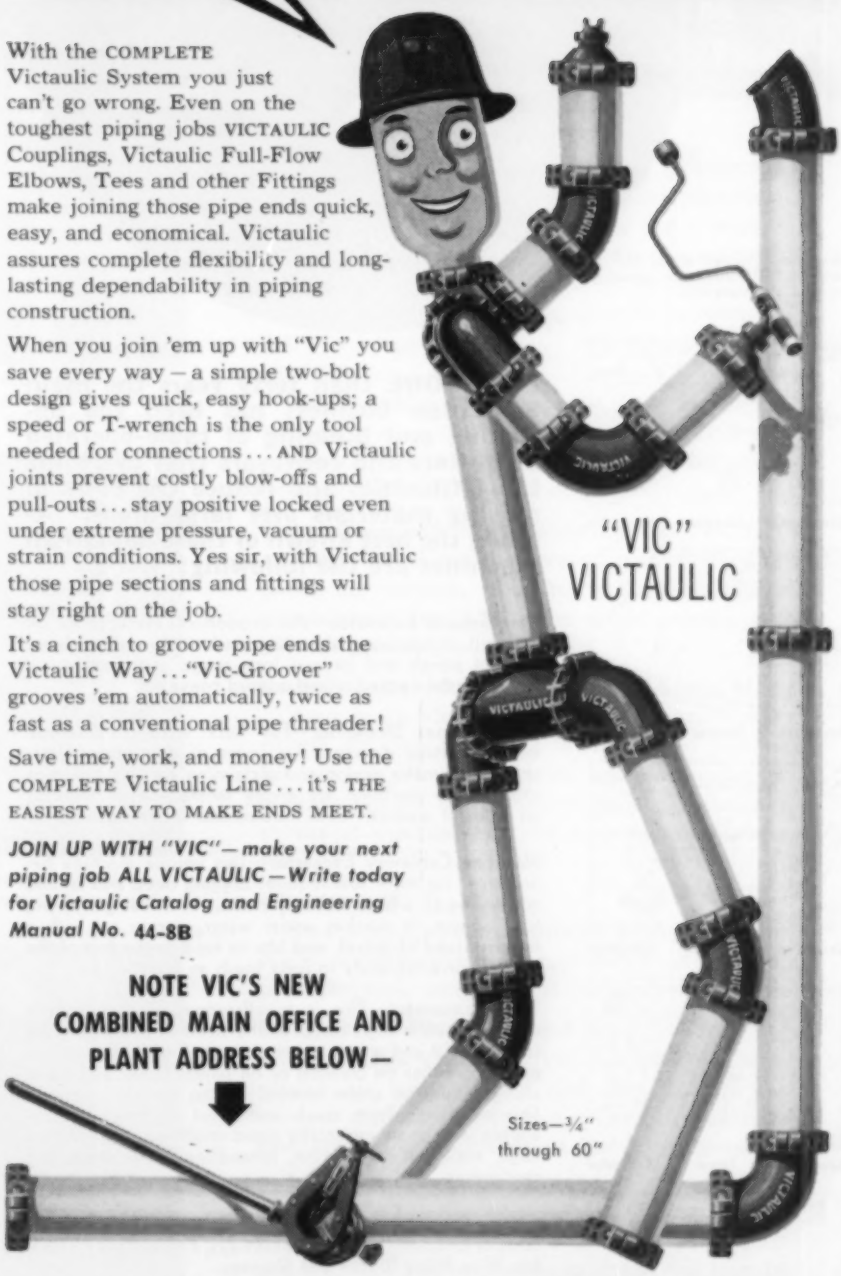
With the COMPLETE Victaulic System you just can't go wrong. Even on the toughest piping jobs VICTAULIC Couplings, Victaulic Full-Flow Elbows, Tees and other Fittings make joining those pipe ends quick, easy, and economical. Victaulic assures complete flexibility and long-lasting dependability in piping construction.

When you join 'em up with "Vic" you save every way – a simple two-bolt design gives quick, easy hook-ups; a speed or T-wrench is the only tool needed for connections ... AND Victaulic joints prevent costly blow-offs and pull-outs ... stay positive locked even under extreme pressure, vacuum or strain conditions. Yes sir, with Victaulic those pipe sections and fittings will stay right on the job.

It's a cinch to groove pipe ends the Victaulic Way ..."Vic-Groover" grooves 'em automatically, twice as fast as a conventional pipe threader!

Save time, work, and money! Use the COMPLETE Victaulic Line ... it's THE EASIEST WAY TO MAKE ENDS MEET.

JOIN UP WITH "VIC"—make your next piping job ALL VICTAULIC—Write today for Victaulic Catalog and Engineering Manual No. 44-8B



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Victaulic Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 406 Hopewell Ave., Toronto 10
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27TH VICTAULIC YEAR

The easiest way to make ends meet
VICTAULIC
PIPE COUPLINGS AND FITTINGS

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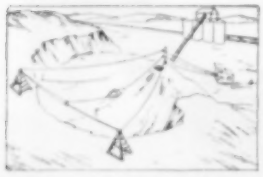
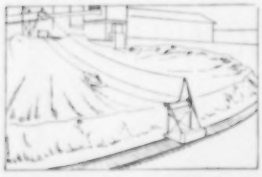
Only SAUERMAN OFFERS ALL THESE LONG RANGE MACHINES

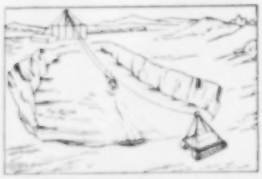
Sauerman Scraper stores and reclaims 150,000 tons of stone on dock at cement mill.



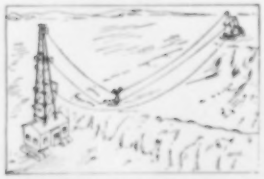
Sauerman Scraper Excavator



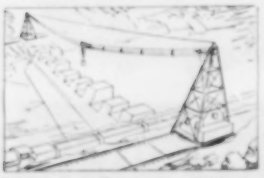
Sauerman Scraper Stockpiler



Sauerman Slackline Cableway



Sauerman Tower Excavator



Sauerman Tautline Cableway

FOR MORE than forty years the main Sauerman business has been the designing and building of cable-operated excavators and conveyors that overcome the difficulties and reduce the costs of moving materials over large areas. Among the best known of these Sauerman machines are the following:

Drag Scraper Excavator—An economical machine for pit and hill excavation, rehandling industrial wastes, cleaning out ponds and general long range earthmoving. It is a powerful excavator and a rapid conveyor.

Drag Scraper Stockpiler—For bulk storage, Sauerman engineers have developed a series of drag scraper machines that make storing and reclaiming an easy one-man job. These machines are giving satisfaction in handling all kinds of materials both indoors and in the open.

Slackline Cableway Excavator—This unique machine has no equal for work that requires digging deep and far and conveying to a high delivery point. In a wet gravel pit, for instance, it reaches under water, comes up with a heaping load of gravel, and lifts its load to the top of the plant, delivering thirty to forty loads an hour.

Tower Excavator—This is a self-propelled drag scraper machine with a high tower at the head end carrying the scraper hoist and a low tower at the tail end. Towers are mounted either on crawlers or on swivel trucks and move along in unison under control of the scraper operator. This machine's long reach and great digging capacity enable it to show especially good results on strip mining. large scale pit excavation, rehandling mine waste and stockpiling.

Other Sauerman Machines — Sauerman also builds Scraper-Loaders, Tautline Cableways, Power Rakes, Durolite Wire Rope Blocks and Sheaves.

LITERATURE — Tell us which of the above machines interest you and we will send concise, easy-to-read catalogs giving you detailed information.

SAUERMAN BROS., Inc.

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Cableway and Scraper Specialists Since 1909

Books and Industrial Literature

A small jobbing machine shop, established in Louisville, Ky., in 1880 by Henry Vogt, began to make tubular boilers a few years later and has since then gradually grown to the stage where it does a world-wide business as Henry Vogt Machine Co., Inc. Today it turns out steam generators for power plants, pressure vessels of all types, heat exchangers, and special equipment for refineries, chemical plants, and process industries in general. It was among the pioneer refrigeration-machinery builders (1895), and this line now includes an automatic tube-ice machine. When the concern had trouble with screw fittings purchased for its use, it started a drop-forge department that now makes one of the most complete lines of steel-piping products available for handling gases and liquids at high or low pressures and temperatures. A fully equipped foundry contributes suitable castings and does special work to customers' specifications. The seventieth-anniversary edition of its products catalogue —a 400-page bound volume—is now being distributed. The company office is located at 10th and Ormsby Streets, Louisville 10, Ky.

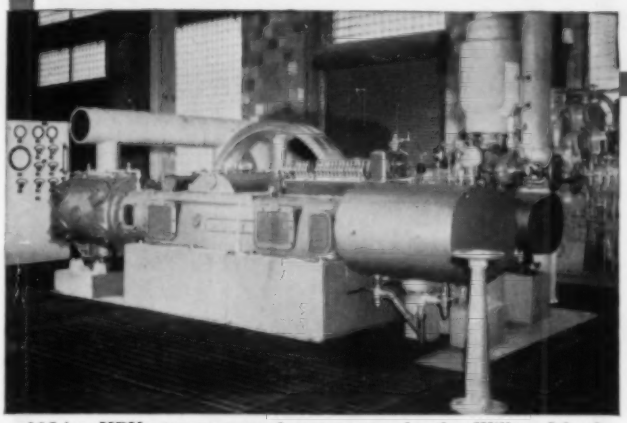
Control systems for temperature, pressure, flow, liquid level, and humidity are covered in Catalogue No. 8304 issued by the Brown Instruments Division of Minneapolis-Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 44, Pa. It describes several pieces of equipment not listed in previous editions.

The tremendous increase in the use of Carboloy (cemented tungsten carbide) is reflected in the 1951 catalogue of the Carboloy Company, Detroit 32, Mich. The new publication contains 60 pages and lists many items for the first time. Many applications of carbide for other purposes than tools are noted. To assist the prospective user in making a suitable selection, the differences in the various grades of carbide are discussed. The catalogue's appearance is enhanced by a liberal use of 4-color illustrations.

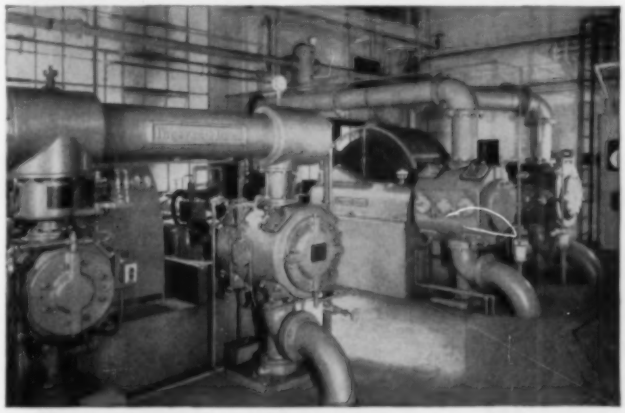
Revised standards relating to hydraulic cylinders as adopted recently by the Joint Industry Conference on Hydraulics have been incorporated in a 16-page booklet prepared by Miller Motor Company, manufacturer of air and hydraulic cylinders. Included are two pages of symbols, a sample hydraulic circuit that makes use of the symbols, a glossary of pertinent terms, and information on service types of pistons and rod seats available for different applications. The booklet, designated as J.I.C. Standards, will be sent gratis on request to the company at 4027 N. Kedzie Avenue, Chicago 18, Ill.

In Etna, Pa., which was named for the famous volcano in Italy, H. S. Spang & Son began making wrought-iron farming implements in 1828. Twelve years later the firm produced the first iron pipe turned out west of the Alleghenies, and it replaced some of the inefficient wooden pipe then in use. In 1856, John W. Chalfont joined the firm and it became the Spang-Chalfont Company. It still makes pipe, but the methods and materials have, of course, changed vastly through the years. A new 92-page bulletin, *Spang CW Pipe* (CW stands for continuous weld), describes the manufacturing process in nontechnical language and illustrates each step. Specifications are listed for black and galvanized pipe in sizes from ⅛ inch to 4 inches.

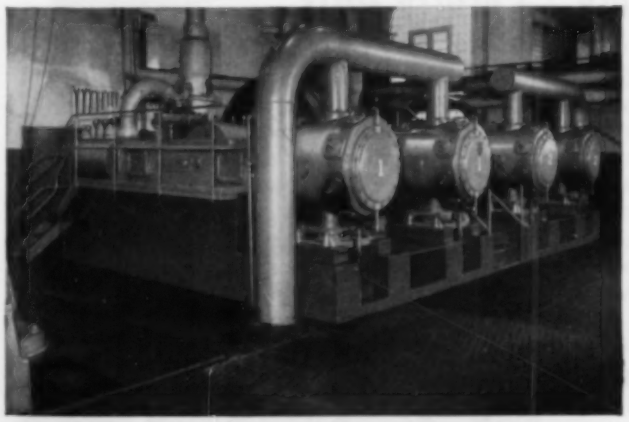
American Cyanamid Company *needs* and *buys* Dependable Equipment



235-hp XPV steam-powered compressor in the Willow Island powerhouse supplies air for plant processing operation, plant process-control instruments, and powerhouse combustion-control instruments.



These two XRE electric-driven compressors in the Bridgeville, Penna. plant supply air for reactors, and for control instruments.



Two 366-hp XPV steam-powered compressors in the Bound Brook, N. J. plant supply air for general plant service.

I-R Compressors, Pumps, and Ejectors are in All Plants

● American Cyanamid Company produces a great number of chemical and pharmaceutical products in its many plants. In the manufacture of products such as aureomycin, all processes must be well co-ordinated. And dependability of the associated equipment is essential for the dependability of the manufactured product.

Ingersoll-Rand equipment plays an important part in such processes as the production of aureomycin. Here are some of the I-R products used on this, and other applications:

Calco Chemical Plant, Bound Brook, N. J.

Three XPV steam-powered compressors on plant air service, two heavy-duty ammonia compressors, ten ALV river-water pumps, and several portable compressors.

Lederle Laboratories Plant, Pearl River, N. Y.

Two large electric-driven compressors supplying air required on a fermentation process for aureomycin production, several condenser coolant pumps for the same process, and four steam-jet ejectors also on aureomycin process work.

Warners, N. Y., Plant

Steam-jet ejectors on process work, PRE and XRE electric-driven compressors on general plant service, and several boiler-feed pumps.

Bridgeville, Penna., Plant

Two XRE electric-driven compressors supplying air for reactors, and also for process control instruments in the plant and combustion control instruments in the powerhouse.

In other American Cyanamid plants there are more examples of reliable I-R machinery, each machine giving the dependability that is needed. Ask I-R engineers to show *you* how to buy dependability.

583-1

Ingersoll-Rand

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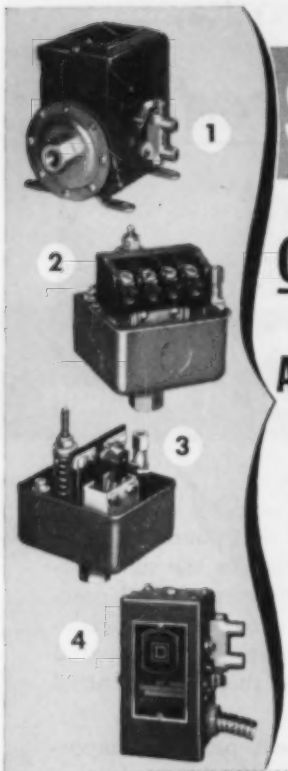

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FOR A

Complete Line

OF H.P. RATED

AIR COMPRESSOR SWITCHES

1. Heavy Duty
2. Intermediate Duty
3. Gas Engine Cut-Out
4. Magnetic Unloader

all with or without Release Valves

Write for Bulletin 550, Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

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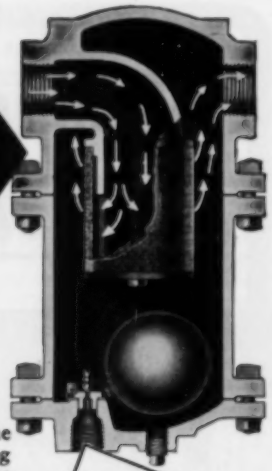
DETROIT · MILWAUKEE · LOS ANGELES

NO MOISTURE OR DIRT GETS BY HERE



Johnson Self-Draining Compressed Air Separator.....

Like all Johnson Separators the new Type "SA" Self-Draining Separator combines the two most effective principles of removing moisture and dirt from compressed air:

1. Controlled expansion of air in separator precipitates most of the moisture.

2. A "thousand baffles" of coarse mesh repeatedly changes flow of direction to capture remaining foreign matter.

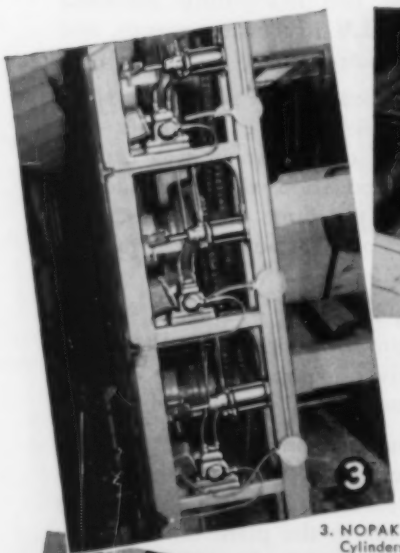
Johnson Separation Devices include Separators for Compressed Air or Steam. After coolers, oil absorbers.

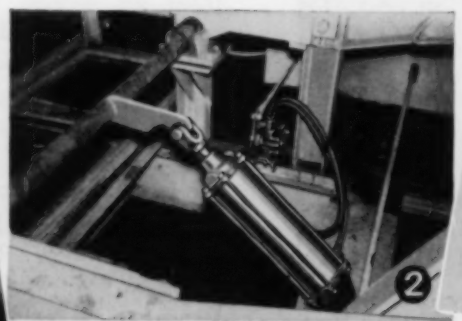
Self-Draining—a simple but complete trap mechanism built right in, automatically drains separator whenever necessary.

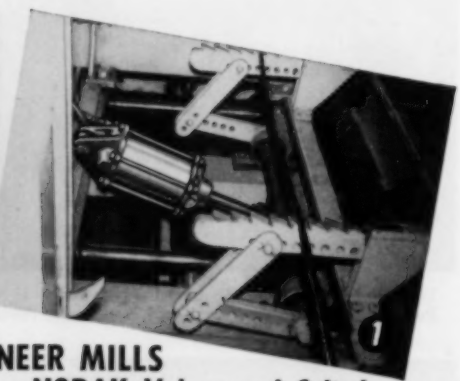
WRITE FOR CATALOG

The Johnson Corporation

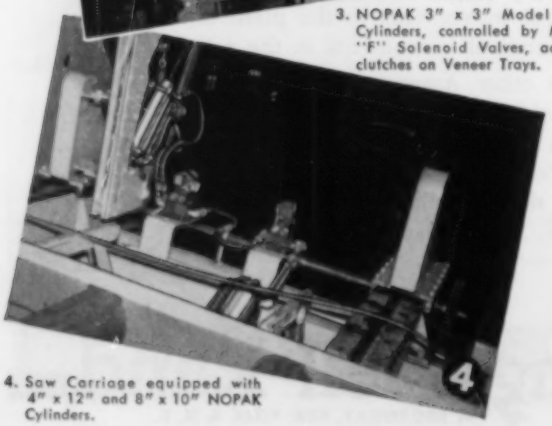
830 WOOD STREET · THREE RIVERS, MICH.







1. Cant Flipper actuated by NOPAK Model "E" Cylinder.
2. Log Deck Flipper-Arm Set-Up operated by 6" x 18" Model "E" Cylinder controlled by NOPAK Model "R" Foot Valve.
3. NOPAK 3" x 3" Model "E" Cylinders, controlled by Model "F" Solenoid Valves, actuate clutches on Veneer Trays.



4. Saw Carriage equipped with 4" x 12" and 8" x 10" NOPAK Cylinders.

LUMBER and VENEER MILLS Find Many Uses for NOPAK Valves and Cylinders

The four applications pictured here are typical of hundreds now in operation in the lumber and wood products industries. Lifting, tilting, pushing, pulling and clamping operations are readily simplified and accelerated through proper application of NOPAK Valves and Cylinders of the correct size and type.

In modernizing machines or equipment which you use in your own plant, or build for others, consider the advantages of using Air or Hydraulic Power the NOPAK way. For data and descriptions, refer to Sweet's File for Product Designers, or write for Bulletin SW-1.

GALLAND-HENNING MFG. CO., 2759 S. 31st Street, Milwaukee 46, Wis.

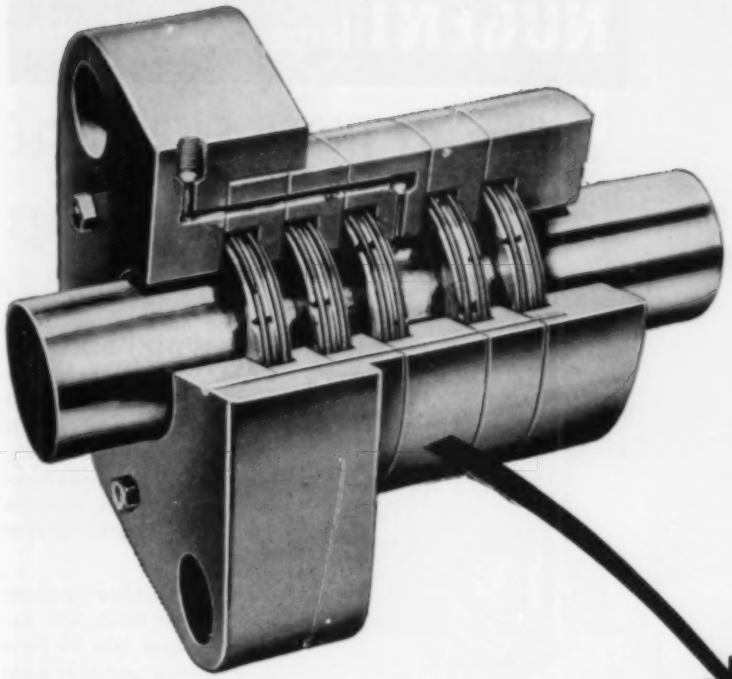
Representatives in Principal Cities

NOPAK

VALVES AND CYLINDERS

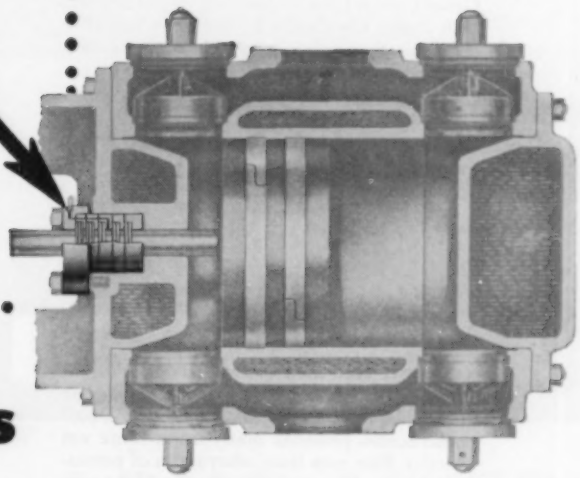
DESIGNED for AIR and HYDRAULIC SERVICE

A 5913-½H-A



MODERN PACKINGS

boost the efficiency of MODERN COMPRESSORS



COOK

Metallic Rod Packings

Now, as never before, design engineers are taking advantage of modern friction-reducing devices in order to improve compressor efficiency and dependability.

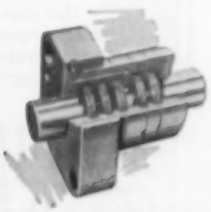
This is why Cook full-floating all-metallic packings are used as the modern rod seal in so many newly developed compressors. Backed by over 60 years of specialized experience in the manufacture of piston rod seals, Cook packings are designed to function with a minimum of friction. They do this primarily by utilizing rings of proven anti-friction materials. These rings float in specially provided grooves which means that, even when rod vibration or misalignment develops, friction is not materially increased nor is the seal disturbed.

Be sure that your compressor comes equipped with this modern packing. Specify Cook by name when you order new equipment just to make sure.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK GRAPHITIC IRON

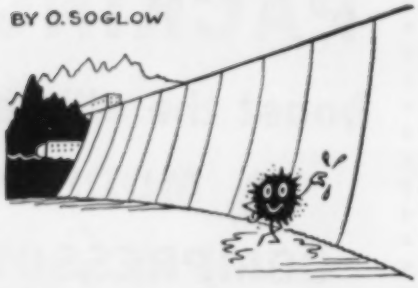
ROD PACKINGS



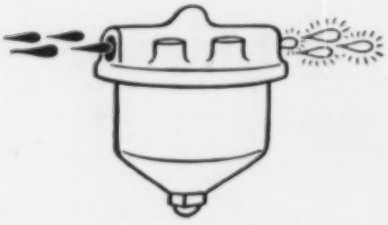
. . . SEALING PRESSURES SINCE 1888 . . .

AIR-MAZING FACTS

BY O. SOGLOW



DUST FIXES DAM. When 30,000 gallons of water per minute began leaking through the Grand Coulee Dam, engineers plugged the leak with dust! They used bentonite, a volcanic clay dust that holds up to 15 times its own volume of water.



KEEPS OIL SPIC AND SPAN. Air-Maze liquid filters remove abrasive particles from engine lubricants, fuels and hydraulic fluids. "Disc" construction provides many times more net effective filter area than other types of permanent filters. All-metal construction. Like new after cleaning.

DUST SURRENDERS! Damaging dust can't get into vacuum pump engines equipped with Air-Maze closed-circuit Multimaze filters. Multimaze filters remove practically all abrasive dust and grit. They're easily serviced—of all-metal construction.

WHETHER YOU BUILD OR USE engines, compressors, air-conditioning and ventilating equipment, or *any device using air or liquids* — the chances are there is an Air-Maze filter *engineered* to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

AIR-MAZE

The Filter Engineers

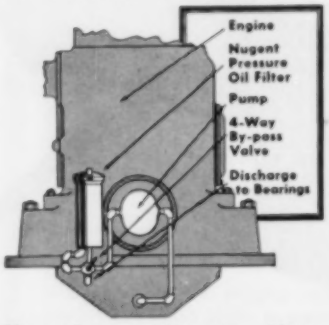
AIR FILTERS
SILENCERS
SPARK ARRESTERS
LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

NUGENT large-capacity filters

. . . filter ALL THE OIL EVERY CYCLE

BEFORE it goes to the bearings

Nugent bag-type lube and fuel oil filters remove contaminants and dirt *as soon as they get into the oil and none is by-passed* to the bearings. IT'S THE OIL YOU BY-PASS THAT DOES THE DAMAGE. That the by-pass partial filter is outmoded and dangerous when used alone is proved by actual field tests, wherein bearing renewals showed a decided drop after the adoption of Nugent *full-flow filtering.*

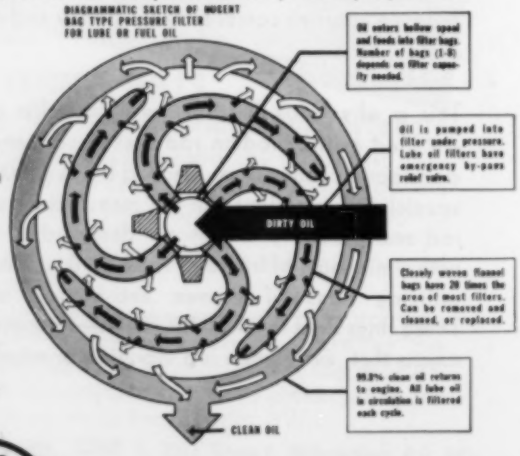


Further, Nugent bag-type lube and fuel oil filters with expendable bags have 20 times more filtering area than other filters of comparable size. Using a Nugent filter, you'll be able to clean more oil per hour, with fewer changes of filter elements. This is particularly important in full-flow systems, where all the oil in circulation each cycle is being cleaned.

The illustration above shows a Nugent full-flow filtering system. Note that the oil is handled by the engine oil pump—no other pump is needed. Filtering systems of this kind are ready for power equipment of any size. Ask a Nugent engineer to give you full details.

The diagrammatic view below shows the tremendous filtering surface of a Nugent bag-type pressure filter. The bag, designed to be used and discarded, is made of a closely woven lintless material which removes particles as small as a few microns and delivers oil 99.8 per cent clean. This type of filter is ideal for filtering all the lube oil in circulation every cycle before the oil goes to the bearings, thereby removing the dirt as soon as it gets in the oil, and retarding the formation of sludge and acidity. The dirt-filled bags are easily removed without tools, and are inexpensively replaced.

There's a bulletin giving complete information on Nugent bag-type filters. Write for your copy today.

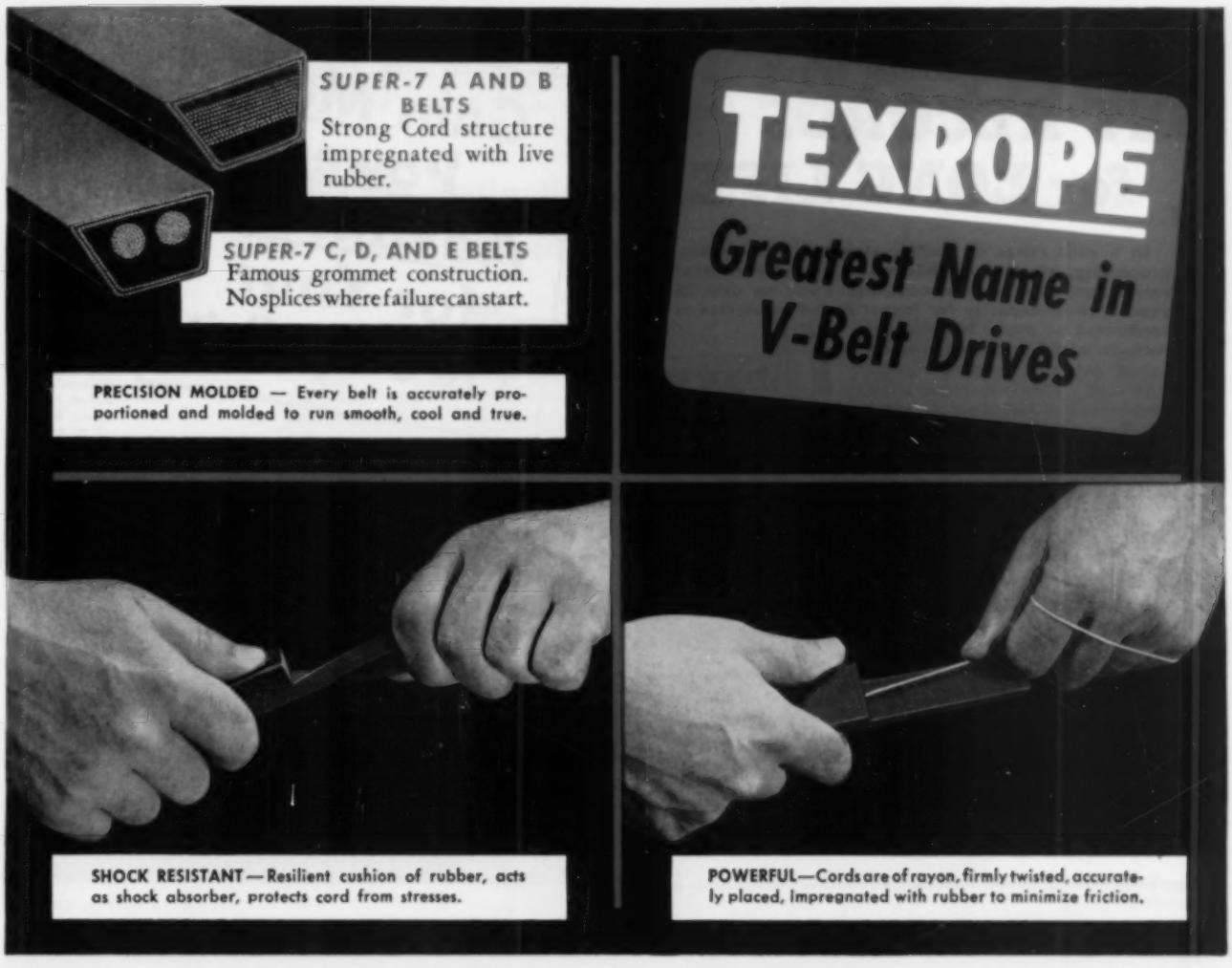


NUGENT TRADE MARK Est. 1897

Wm. W. Nugent & Co., Inc.

1422 N. Hermitage Ave. CHICAGO 22, ILLINOIS

Oil Filters, Oiling and Filtering Systems, Telescopic Oilers, Oiling Devices, Sight Feed Valves, Flow Indicators . . . *Representatives in Principal Cities*


SUPER-7 A AND B BELTS
Strong Cord structure impregnated with live rubber.
SUPER-7 C, D, AND E BELTS
Famous grommet construction. No splices where failure can start.
TEXROPE
Greatest Name in V-Belt Drives
PRECISION MOLDED — Every belt is accurately proportioned and molded to run smooth, cool and true.
SHOCK RESISTANT — Resilient cushion of rubber, acts as shock absorber, protects cord from stresses.
POWERFUL — Cords are of rayon, firmly twisted, accurately placed, impregnated with rubber to minimize friction.

Cool Running... LONG LIVED!

SUPER-7 V-belts give long, satisfactory service even under bad conditions of load, shock and grit.

Tough, double-wrapped cover bias cut for elasticity and impregnated with rubber. Effectively seals out dust, grit, moisture; takes the wear; keeps the belt in shape; and protects cord structure.

But you get more than good belts when you standardize on *Super-7* V-belts. You also get the benefit of the greatest V-belt experience in the world both in the field and factory. You are assured of exactly the right drive for longest life from the wide variety of types and sizes available.

High Capacity Belts

Where space is limited or other special conditions demand heavier duty, the high capacity belt can be furnished in A, B, C, D, and E sections . . . Extra strong cords, special rubber cushion and tough Neoprene cover give them 40% greater capacity than standard belts at proportionately higher price.

V-Belt Drive Headquarters

Your nearby Allis-Chalmers Authorized Dealer or Sales Office can serve all your V-belt needs, whether they be new or replacement V-belts; standard and variable speed sheaves; or speed changers.

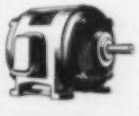
Get your copy of the revised 120 page *Texrope* Pre-Engineered Drive Manual from your A-C Dealer or Sales Office or write for Booklet 20B6956A. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3291

Texrope and Super-7 are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

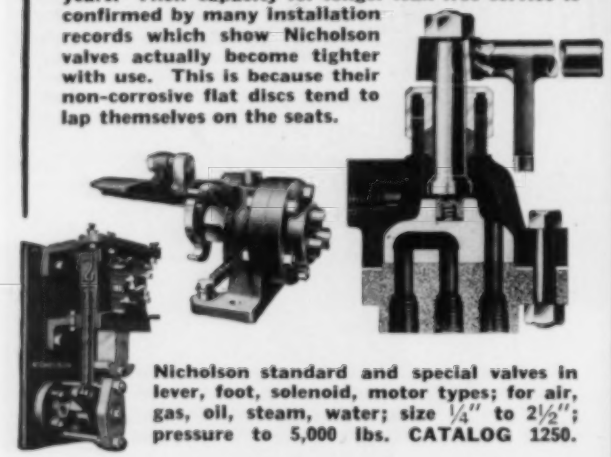
PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

Nicholson Control Valves

SET RECORDS for LONG LIFE

In a wide range of plants—steel, metal working, processing, etc.—many Nicholson cylinder control valves have now been in continuous use for over 25 years. Their capacity for longer leak-free service is confirmed by many installation records which show Nicholson valves actually become tighter with use. This is because their non-corrosive flat discs tend to lap themselves on the seats.

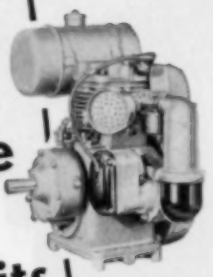


Nicholson standard and special valves in lever, foot, solenoid, motor types; for air, gas, oil, steam, water; size ¼" to 2½"; pressure to 5,000 lbs. CATALOG 1250.

W. H. NICHOLSON & CO. 180 OREGON ST. WILKES-BARRE, PA.

Sales and Engineering Offices in 53 Principal Cities

Gain More Power Advantage for Your 3 to 6 h.p. Units



Models ABN and AKN 4-cycle Single Cylinder Wisconsin Air-Cooled Engines Power Range: 3 to 6 hp.

Presented here are a few of the basic facts why Wisconsin Heavy-Duty Air-Cooled engines offer important advantages to the designing engineer, equipment manufacturer and the ultimate user:

1. Rotary type high tension magneto, with impulse coupling, mounted on outside of engine . . . operates as an entirely independent unit that can be serviced or replaced in a few minutes.

2. Self-cleaning tapered roller bearings at both ends of the crankshaft . . . will withstand side-pull or end-thrust without danger to bearings.

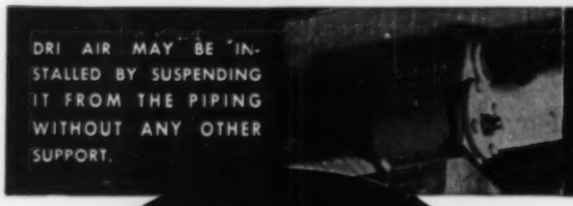
3. Maximum torque at usable speeds . . . most desirable on equipment that really has to go to work.

Our Engineering Department will be glad to co-operate with you in adapting Wisconsin Engines to your requirements. Write for detailed data.

WISCONSIN MOTOR CORPORATION

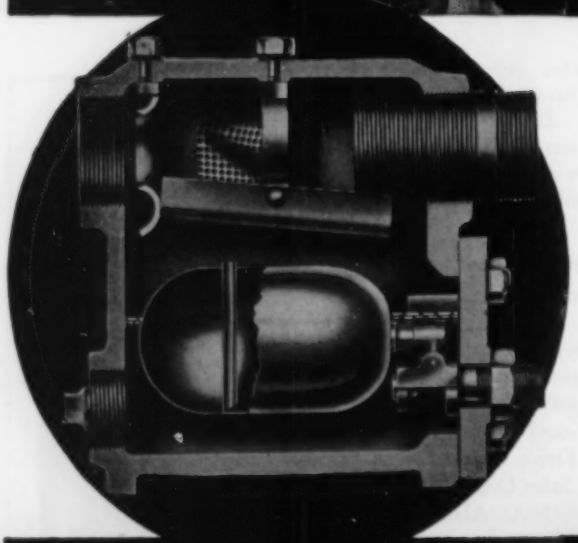
World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46 WISCONSIN



DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

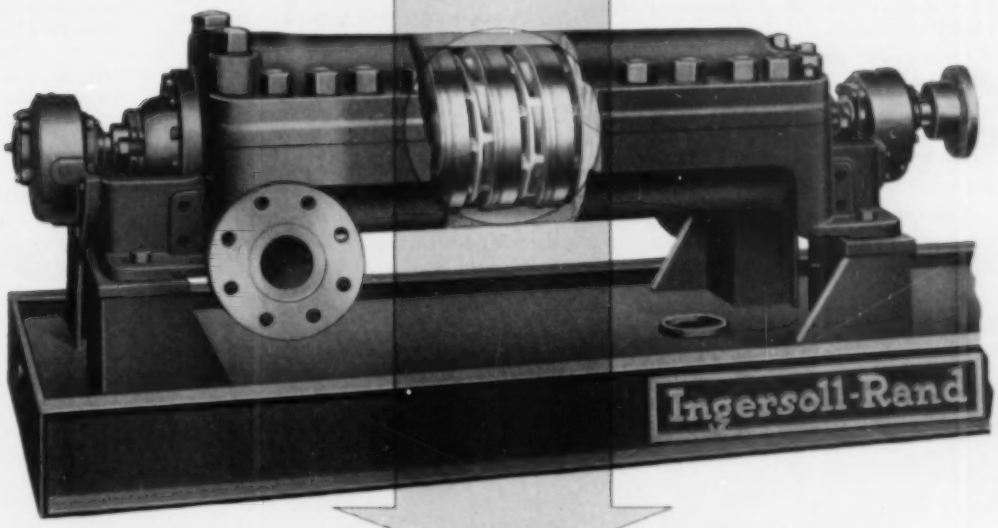
NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

. . . here's the INSIDE STORY

on how the distinctively new HMTA can cut your high pressure pumping costs



A three-inch, nine-stage HMTA pump, with section of the casing cut away to show the rotor assembly installed.

● When it comes to superior performance and economy, it's the construction of a pump that counts. That's why the modern features of the Ingersoll-Rand Class HMTA pump mean so much to you in terms of long-range savings.

The complete Unit-Type rotor assembly removed from the casing.

SIMPLE, UNIT-TYPE ROTOR ASSEMBLY. Impellers, renewable wearing rings and stationary channel rings, containing the multiple volute fluid passages, make up the compact rotor assembly. Interstage sealing rings, compressed between the casing and channel rings, give a positive, metal-to-metal seal between successive stages. All rotor assembly elements are perfectly matched and self-aligning.

HIGH SUSTAINED EFFICIENCY. Multiple volute design, in-line staging and positive, interstage sealing contribute to the high efficiency of these units. And practical running clearances—proportioned for minimum wear—sustain this efficiency over years of service.

RUGGED CONSTRUCTION. The high-strength, symmetrical casing, is free from crossovers or cast volute passages. Complete radial and axial balance assures trouble-free operation over the complete range of pressures and capacities.

COMPACT, ACCESSIBLE DESIGN. The entire rotor assembly can be removed from or installed as a unit in the horizontally-split, smooth bore casing—without disturbing the piping. And the balancing drum, which is the only high pressure breakdown in the pump, can be inspected without opening the casing.

Ingersoll-Rand

Cameron Pump Division 590-10
11 Broadway, New York 4, N. Y.

HMTA

for pressures up to 1400 psi

Ingersoll-Rand Class HMTA pumps are available in capacities to 1600 gpm and pressures to approximately 1400 psi. For complete information on these *distinctively new* multi-stage pumps, write for your copy of Catalog 7233. Or ask your nearest Ingersoll-Rand branch office to give you the complete HMTA story.

COMPRESSORS • ROCK DRILLS
AIR TOOLS • CONDENSERS
DIESELS • GAS ENGINES
CENTRIFUGAL PUMPS

How TIMKEN® bearings keep an air compressor from losing its breath

TO keep excavation and demolition work at the Erie, Pa., water works going at top speed, the jackhammers need a steady, powerful supply of compressed air. And they get it!—from these two Ingersoll-Rand Mobil-Air units.

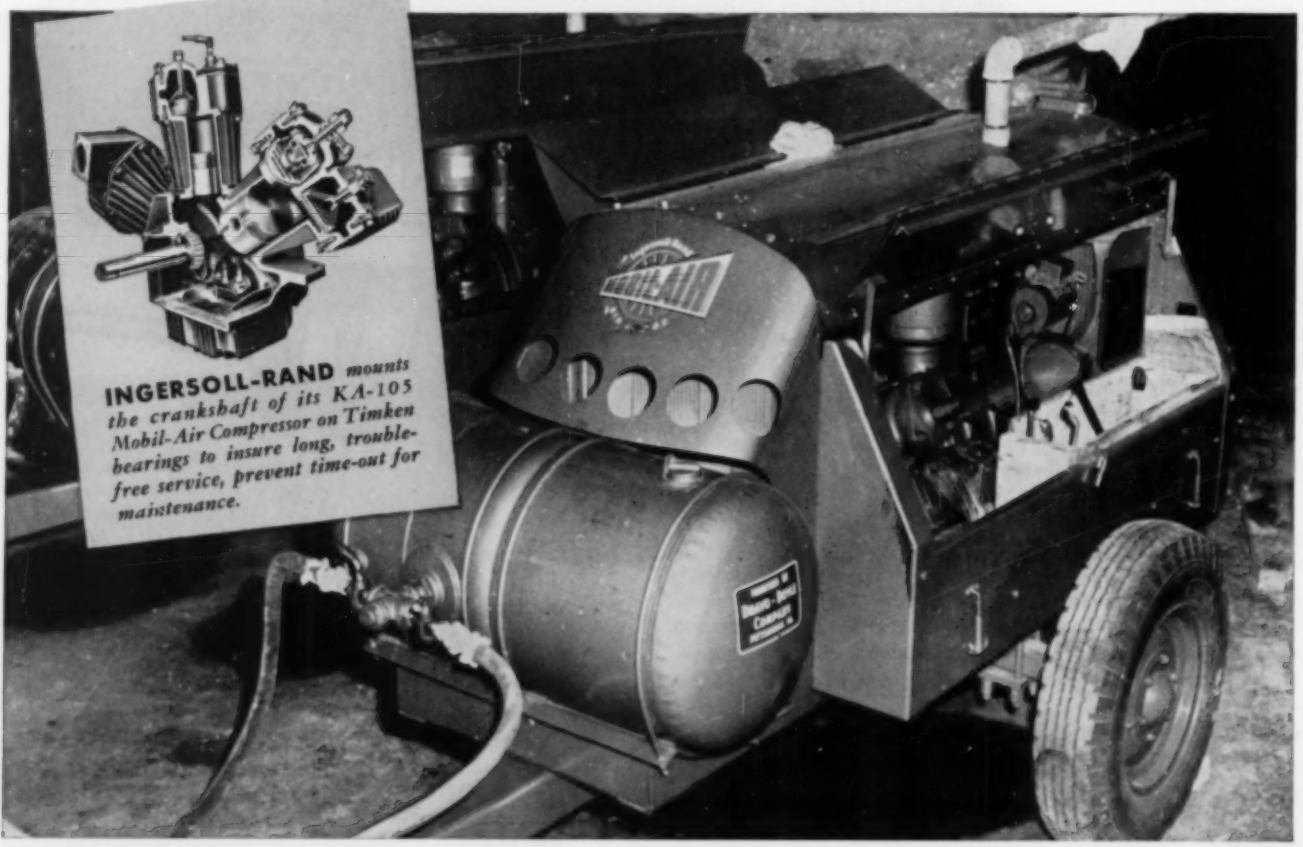
One good reason these compressors don't get winded on the job is because they have Timken® bearings on the crankshaft—the best insurance against costly breakdowns and troublesome delays for maintenance.

Timken bearings keep the crankshaft in positive alignment, practically eliminating deflection and endplay. Wear on moving parts is cut to a minimum. What's more, Timken bearings permit tight, lubricant-retaining closures that keep dirt and moisture out, keep the lubricant in.

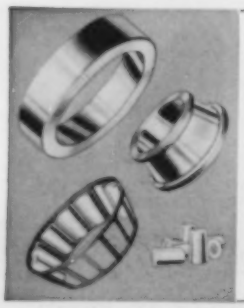
Because of their tapered construction, Timken bearings carry both radial and thrust loads in any combination. Line contact between rollers and races gives extra load-carrying capacity. True rolling motion and an incredibly smooth surface finish makes friction negligible. And Timken bearings are made of the finest steel ever developed for tapered roller bearings—Timken fine alloy steel. Under normal conditions, they'll last the life of the machine.

To get *all* the advantages that only Timken bearings can give, specify them in the machines you build; look for them in the machines you buy. You're assured dependability, low-cost operation and longer machine life, if you make certain every bearing is stamped with the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



INGERSOLL-RAND *mounts the crankshaft of its KA-105 Mobil-Air Compressor on Timken bearings to insure long, trouble-free service, prevent time-out for maintenance.*



DESIGN LEADERSHIP

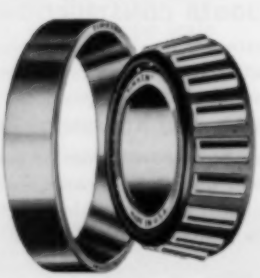
The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roll ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

The Timken Company leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

TIMKEN

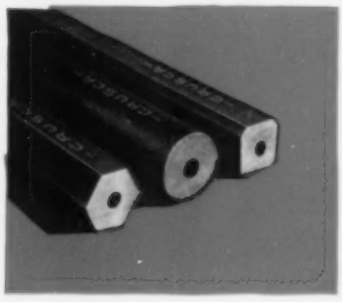
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⇕ AND THRUST →◫← LOADS OR ANY COMBINATION ✳

when the going's tough—



USE CRUCIBLE HOLLOW DRILL STEEL

The long life of Crucible Hollow Drill Steel . . . even under the severest drilling conditions, is the reason why you get lower cost per foot drilled when you use this high quality drill steel. This is no idle claim! Controlled hardenability, perfection of stress-bearing surfaces and uniform processing all contribute to your assurance of maximum performance.

But even more! Every lot of Crucible Hollow Drill Steel is pre-tested for the harder, faster blows of modern drills. Cut down on costly job delay, and get the most out of your drilling equipment . . . specify Crucible Hollow Drill Steel.

Let Crucible Hollow Drill Steel answer your drilling problems. To help you cut drilling costs, Crucible makes freely available to you a field-experienced metallurgical staff. Put us to work — working for you! CRUCIBLE STEEL COMPANY OF AMERICA, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

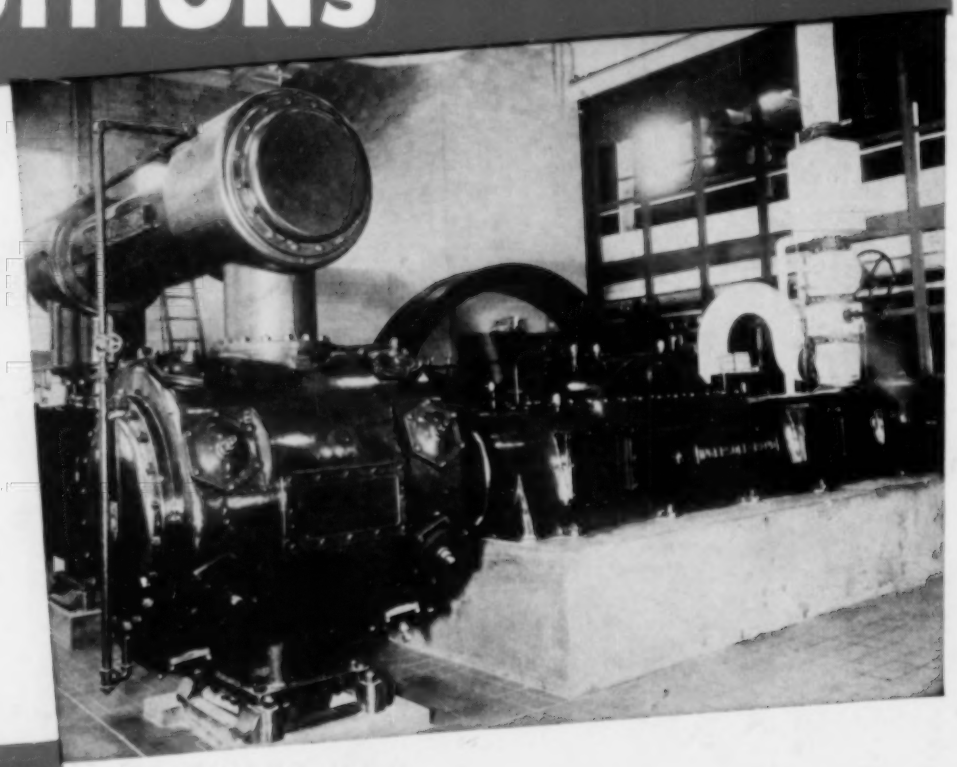
CRUCIBLE first name in special purpose steels

51 years of Fine steelmaking

HOLLOW DRILL STEEL

REX HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

USE THE *EXACT* OIL FOR *YOUR* OPERATING CONDITIONS



...it's in the complete line of Texaco air compressor oils

No matter what your operating conditions, the type or size of your compressors, their speed or pressures, there is a Texaco air compressor oil exactly suited to assure you clean, trouble-free, low-cost performance.

If, for example, severe service is causing carbon and gum formations, you can overcome the difficulty with one of the Texaco *heavy-duty* air compressor oils. If excessive wear is due to "wet cylinder" conditions, the recommendation will be a Texaco *compounded* air compressor oil.

Similarly, you can keep compressors and systems rust-free, whether running or idle, by lubricating with a Texaco *rust-inhibited* air compressor oil . . . and, for "normal" conditions, your best assurance of clean, efficient operation is a Texaco *straight mineral* air compressor oil.

A Texaco Lubrication Engineer will gladly help you select the proper oils to assure you cost-saving compressor lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.